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ABSTRACT

This project aims to provide basic steps for students to restore and create wildlife habitats on school grounds. Four chapters are included in this guide, and each chapter is divided into teacher and student sections. Chapter 1 provides necessary information for starting a habitat project. Chapters 2, 3, and 4 discuss the details for the Forest Habitat Project, the Wetland Habitat Project, and the Meadow Habitat Project. (YDS)

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Schoolyard Habitat Project Guide

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Schoolyard Habitat Project Guide

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To order additional copies call 410/573 4593, 410/573 4500.
The guide can also be downloaded from our website:
http://www.fws.gov/r5cbfo/schoolyard.htm

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Introduction

About this guide

The purpose of this guide is to provide the basic steps needed to restore or create wildlife habitat. It is designed so that students complete several tasks that will lead to establishing a forest, meadow or wetland on school grounds. The projects can range in size from a small 20' by 20' area to an acre or more. These steps were developed from the experiences of several schools that have completed similar projects. The process incorporates critical thinking and decision-making skills while challenging students in reading, writing, science, mathematics and language arts.

This guide is mostly self-explanatory. The first chapter covers logistics and general information about starting a project and challenges students to complete a project proposal. Subsequent chapters cover the details on how to complete wetland, meadow or forest habitat project. The chapters are divided into teacher sections and student sections.

There are several other guides available that go into other aspects of habitat projects such as mapping or social issues. A list of additional guides can be found in the appendix.

The Rationale

A schoolyard with a diverse landscape offers much more to students and the community than the typical barren schoolyard. Many of the benefits of establishing habitats are obvious while others are less obvious yet very important. Some of the benefits include:

Teaching and learning

A diverse schoolyard landscape offers many teaching and learning opportunities in science, English, mathematics, history, geography, social studies and art. The process of planning, implementing and using a habitat project provides children with a unique hands-on learning experience.

Informal learning

Experts know that child play is an important part of learning. A diverse schoolyard setting offers many informal learning opportunities when children are outside for recess, lunch or even after school.

Hidden messages

The landscape carries a hidden message as students develop a perception of what a normal landscape looks like. Schoolyards are typically open and barren with a few scattered landscape plants. It is not a coincidence that most of our yards are open landscapes with ornamental plants. Conversely, children that attend schools with natural landscape features will have a much different perception of a typical landscape, one that coincides with conservation of natural environments.

Improved habitat

School habitat projects provide habitat for local and migratory wildlife and, in many cases, provide a vegetative buffer to nearby streams.

Chapter 1

Getting Started
Teacher Section

Organizing the project

There are many different ways to organize and coordinate a school habitat project. The following are some general suggestions:

Form a team

Pull together a dedicated team of students, teachers, parents, community members and natural resource experts to facilitate the project. *It is strongly recommended that you invite your grounds maintenance supervisor to join the team. This person can be a great asset or, if left out, can make things very difficult.* As the project evolves, the team can be broken into groups to accomplish different tasks such as fund raising, community outreach, organizing planting and finding equipment.

Set Goals

Setting goals will establish what you want to accomplish and set parameters for the project. For instance, throughout the guide, using native plants is strongly advocated. Parents may be eager to donate a hodgepodge of plants to your effort. If one of your goals is to use native plants, then you should graciously turn down donations of non-native, ornamental plants that would not fit within the goal of an ecologically sound project.

Communication

Students can communicate with their local community by developing a flyer, doing a presentation or inviting others to participate. The projects advocated in this guide are natural area restoration projects. These projects will, at some or all times during their development, be perceived by some people as weedy or overgrown. Therefore, good communication with neighbors is crucial.

Assistance

For additional help, contact some of the following groups:

- natural resource experts (lists are given in each section)
- parent/teacher organizations
- local environmental groups
- college students
- local businesses
- grant-giving organizations
- senior citizens
- scout groups
- civic groups

Note:
Be careful not to let the experts or volunteers do the project for you. Remember students should be doing the project.

Documentation Create a journal where students can keep track of all the information about the project. Include pictures, drawings, receipts, grants and newspaper articles. This is a very important and useful step that many schools leave out.

Signs It is very helpful to put up signs advertising the project as a wildlife habitat restoration. This will let people know that you haven't forgotten to mow the lawn, and that you are doing something very beneficial for wildlife and for your watershed.

Maintenance

- The success of any project involves a detailed maintenance plan.
- Design the project to reduce maintenance (less mowing).
- Communication with mowing supervisor is essential.
- A summer watering plan is essential the first year.
- Develop a long-term maintenance plan. The most important element may be identification and removal of invasive plants.

Instructional strategies

Student Role. In order for the students to take ownership in the project, they must be able to make decisions and use their critical thinking skills throughout the project.

Student Teams. Most teachers divide students into small groups to complete the tasks. In certain parts of the project, some tasks must be done in order. In other parts, several tasks can be done concurrently. Read through the steps to determine the best way to organize the students.

For most projects, a class, grade level or after-school group is responsible for completing the steps that lead up to planting the habitat. Additional classes or even the entire school can help with planting day.

Mapping and Observational Drawing. There are several opportunities throughout the process for students to make maps and do observational drawings. These are noted in the teacher section, although the guide does not provide instructions on how to do this.

Tips for working with natural resource specialists In order to maximize the environmental benefits of the project, it is helpful and sometimes essential to ask a natural resource specialist for advice. Most are more than happy to help. Caution: sometimes people can be too helpful and make many of the decisions students should be making. For instance, students should be making decisions about which plant species to use. The resource specialist should review and comment on the students' plant choices.

Suggested questions for a natural resource specialist:

1. What natural habitat projects (plant a meadow, reforestation, build a wetland, restore a stream) are possible on our site?
2. What project will provide the most environmental/ educational benefit?
3. In what ways can you help?

Themes for the project

Several themes that can be threaded throughout the project:

Wildlife habitat. The obvious theme is creating habitat for wildlife. Amphibians and Neotropical migratory birds are two major groups of wildlife that are of special concern due to recent global population declines. You may want to focus on these two groups of animals throughout the project.

Watershed protection. Nearly all land drains into a body of water, including streams, rivers, lakes, wetlands, bays and oceans. Good land management includes restoring natural habitats as advocated in this book and is key to protecting aquatic systems.

Biodiversity. Loss of biodiversity, of both plants and animals, is a concern of our society. Through habitat projects, students can learn about and enhance the biodiversity of their schoolyard. Using only native plants is a good way to promote biodiversity.

Native plants include those that occur in natural habitats in your region of the country

Using native plants

Most natural resource specialists strongly suggest using only native or indigenous plants for habitat projects. A few reasons to use native plants include:

- Native plants make up the physical structure of natural biotic systems.
- Animals depend on native plants through complex, sometimes poorly understood, interactions.
- An often overlooked but important function of native plants is the critical habitat they provide for insects. Insects are a major link in the food chain and are vital for pollinating food crops for people.
- Many native plants produce food for people and wildlife.
- Native plants have interesting features including blooms, stem color, form and aromatic qualities.
- Native plants are adapted to the local climate and require less care.
- Native plant communities help define a sense of place about an area.

Step 1
Complete habitat survey

In this first step, students will complete a general habitat survey of the school grounds. Each student team can survey a portion of the school grounds. Students can make a map of the part they surveyed. The maps can be pieced together into one large map of the entire site.

Materials
copies of pages 12-16
clipboards

Step 2
Complete wildlife survey

This is a generic inventory of wildlife that students can do before starting the project. This will give them a baseline to compare to after habitat improvements are made. The task is to keep track of the number of different species the students see, hear or find evidence of. They don't need to know the names of the species. The number of species seen will be related to the habitat and the time of year. More species will be seen as the weather gets warmer. After the students improve the habitat, repeat the survey to see if the diversity of species increases. To limit the variables, follow-up surveys should be done at about the same time of year.

A school-wide plan (optional step)
Review the plan from Centreville Middle School on page 9. Long-range plans have the following benefits:

- Grant-giving organizations prefer projects with ongoing activities.
- Thousands of students can be involved over time.
- Community support builds on large, long-term projects.
- Environmental benefits are cumulative.

Materials
copies of pages 17
clipboards

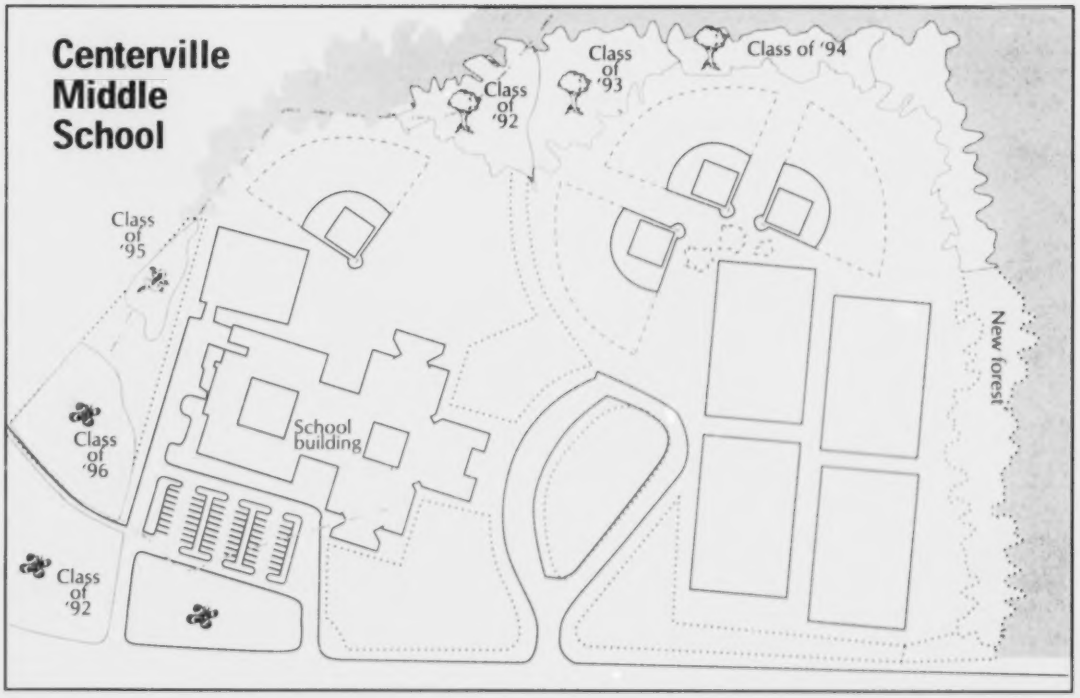
Step 3
Complete project proposal

In this step, students will use knowledge gained in Step 1 to develop a proposal for habitat improvement. The chart on page 19 provides a general idea of the different types of projects that are possible given the environmental factors of the site. You will need to decide how the class will come to a consensus about which project to work on.

Materials
copies of pages 9, 18-22

Planning the project

After you decide on the type of project to do, refer to the appropriate project section for details.



Students at Centerville Middle School have been working since 1992 to restore native plants and animals to parts of the schoolyard. The first step was to identify all the areas where habitat could be improved. All of these areas were grass or bare ground. As of 1996, students have changed 1.8 acres of land into new forests, meadows and a shallow wetland area. There are many new types of birds, frogs and butterflies that students now see regularly that were never seen before their efforts began. By eliminating 1.8 acres of mowing, the school saves $800 per year in maintenance costs. When the project is complete, sometime beyond the year 2000, students will have changed about 5 acres of unused lawn into natural habitat.

- Existing forest
- Potential restoration area
- Intermittent stream
- Reforestation (completed)
- Meadow (completed)
- Wetland (completed)

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Getting Started

Student Instructions

Your class has decided to do a wildlife habitat project. There are several steps involved. First you will read about different habitats and complete a habitat survey of your schoolyard. Based on what you learn from your survey, you will decide on the type of habitat to establish. Next, you will develop a plan or proposal that your principal must approve. After completing this first section, you will complete more detailed steps for your specific type of habitat project.

Step 1
Complete habitat survey

Your task is to read the following:
All Things are Connected below
Habitat Types pages 13, 14
Then, go out to your schoolyard and complete the
Habitat Survey pages 15, 16

Fact Sheet: All Things are Connected

Habitat

A habitat is home for a plant or animal. A habitat provides basic needs— food, water, shelter and space. In most habitats, plants provide many of the basic needs for animals. Plants provide food from nuts, seeds, berries, fruit and nectar. Plants also provide shelter and space to make nests and raise young. Plants provide habitat for many different insects. Insects are a major food source for many other species of wildlife. Habitat loss is the primary threat to many animal and plant species.

Watershed

Your school is in a watershed. All land is in a watershed. A watershed is an area of land that drains or sheds its rainwater and springs into a body of water such as a stream or lake. Natural habitats like forests, wetlands and meadows are good to have in watersheds. Natural habitats help filter and remove pollutants in runoff water. They also act like a sponge to trap runoff water, then slowly release clean filtered water into nearby streams. Slower moving runoff water reduces streambank erosion. Streambank erosion smothers stream life and is one of the most widespread environmental problems.

Biodiversity

Biodiversity is the variety of life or the number of different plants and animals in an area. Areas that have high diversity of native plants usually also have a high diversity of animals. People have changed the land and, in many cases, these changes lead to less diversity of native plants. Some species have adapted to changes that people have made while other species have not. Plant and animal species have disappeared from certain areas or have even become extinct. This causes a loss of biodiversity.

People are making progress towards restoring habitat, protecting watersheds and conserving biodiversity. Much of this progress is made by protecting and restoring natural areas including wetlands, streams, forests and meadows.

Habitat Types

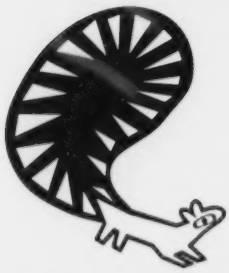
Forest: An area dominated by large trees but also many other plants, including shrubs, small trees and herbaceous plants like ferns. Decaying leaves and trees cover the forest floor. Forests provide a wide range of food, shelter and space for many animals. Some forest species include deer, raccoons, squirrels, chipmunks, opossum, red-tailed hawks, sharp-shinned hawks, scarlet tanagers, wood thrushes, American redstarts, spotted salamanders, wood frogs, spring peepers, box turtles and black rat snakes.

Scrub/shrub: An intermediate stage between a meadow and forest that has a dense overgrown look. This habitat has a very diverse plant community of tall grasses, wildflowers, shrubs and tree seedlings. Dense shrubs provide excellent cover, space and food from berries. Scrub/shrub species include many of the same species found in a meadow. In addition, catbirds, towhees, cardinals, flycatchers and warblers are also found here.

Habitat Types

Meadow: An area with tall grasses and wildflowers. In the Central United States this type of grassland is called a prairie. Meadows provide dense cover for ground-nesting birds and burrowing animals and space for many insects. Some meadow species include rabbits, groundhogs, voles, foxes, sparrows, quail, goldfinches, bluebirds, hawks, some reptiles and amphibians and many insects, including butterflies.

Wetland: There are many different types of wetlands. All have three characteristics: water, saturated soil and plants adapted to wet conditions. A marsh is the wettest type of wetland and is dominated by herbaceous plants, like cattails. A swamp is a wetland dominated by trees. Some wetland species include muskrat, beavers, deer, voles, ducks, herons, shorebirds, kingfishers, red-shouldered hawks, dragonflies and butterflies. Nearly all species of amphibians lay eggs in wetlands.



Habitat Survey

Take a walk around your school site. Use the checklist to keep track of how well your schoolyard provides habitat for wildlife.

Your task is to:

- Rate each section on a scale of 1 (lowest) to 5 (highest).
- Make notes on ways to improve the habitat
- Keep a list of areas where you think habitat can be improved.

Wildlife habitat checklist	**Rating**	**Ways to improve**
Food	*(lowest)* *(highest)*	
nuts	1 2 3 4 5	_____
seeds	1 2 3 4 5	_____
berries	1 2 3 4 5	_____
nectar	1 2 3 4 5	_____
insects	1 2 3 4 5	_____
Water		
a wet area present all year	1 2 3 4 5	_____
a wet area present part of the year	1 2 3 4 5	_____
Shelter		
thick brush and brambles	1 2 3 4 5	_____
tall grassy fields	1 2 3 4 5	_____
woodlands with many layers of plants	1 2 3 4 5	_____
streams with forested buffers	1 2 3 4 5	_____
dead standing trees	1 2 3 4 5	_____
rotting logs on the ground	1 2 3 4 5	_____
brush piles	1 2 3 4 5	_____
Space (natural habitats)		
Meadows	1 2 3 4 5	_____
Forests	1 2 3 4 5	_____
Scrub/Shrub	1 2 3 4 5	_____
Wetlands	1 2 3 4 5	_____
Streams	1 2 3 4 5	_____

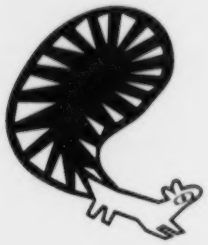
List the areas where habitat can be improved

1.

2.

3.

Step 2
Complete wildlife survey



Go out to the area where you will do your habitat project. Your task is to count the number of different wildlife species that use the area. Counting wildlife can be difficult since many wildlife species are secretive and hide when people are around. Others only come out at night. It is sometimes easier to find evidence of wildlife such as feathers, footprints, scat (droppings) or burrows. Do not be discouraged if you don't find many types of wildlife. If you know the names of different species list them.

		Total
Sample:		
Number of different birds seen or heard: (list names if you know them)	| | |	3
1. Number of different insects and spiders seen (list names if you know them)		
2. Number of different birds seen or heard (list names if you know them)		
3. Number of different reptiles or amphibians seen or heard (list names if you know them)		
4. Number of mammals seen (list names if you know them)		
5. Number of different types of wildlife you see evidence of including tracks, fur, feathers, scat (droppings), nests, chewed food, other. (list names if you know them)		

Step 3
Complete project proposal

In this step your task is to read:

Site Conditions for Habitat Projects page 19
Additional Project Features pages 20-22
Centerville Middle School map page 9

Use this information and the results of your survey to complete the Project Proposal. After completing the proposal, submit it to your principal.

Type of Project

What type of habitat project would you like to do?

List two reasons why.
1.

2.

Location

What part of your school grounds would you like to do it on?

Goal

List at least two ways your project provides for the needs of wildlife, helps biodiversity and helps your local watershed.

Plan

List three steps you will take to complete the project.

Evaluation

Explain how you will evaluate the success of the project.

Site Conditions for Habitat Projects

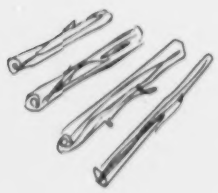
This chart shows the general type of site conditions for each habitat type

	Meadow	**Wetland**	**Forest or scrub/shrub**
Sunlight	*Full sun preferred*	*Full sun to shade*	*Partial to full sun*
Moisture	*Wet to dry*	*Wet to flooded*	*Wet to dry*
Soil	*Most types*	*Silt clay or clay preferred*	*Most types*
Existing plants	*Lawn, bare ground, scattered trees*	*Lawn, bare ground, other*	*Lawn, bare ground, scattered trees*

Additional Project Features

Habitat Features

1.



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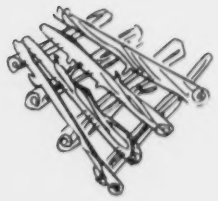

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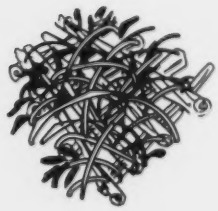

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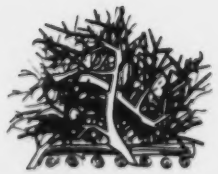


Four steps to building a brushpile

Logs: Rotting logs are habitat for many insects, amphibians and small mammals. Logs are good tools for learning the process of decay and the life associated with it. Logs can be placed in any of the habitat types or anywhere else on the playground. Partially submerged logs in wetlands or ponds provide a place for turtles and frogs to sun.

Snags: Standing dead trees or snags provide nesting cavities for some birds like woodpeckers and chickadees. Insects within snags attract a variety of birds. Predatory birds, like hawks, perch on snags for a better view of prey.

Brushpiles: Brushpiles provide excellent cover for rabbits, chipmunks, skunks, small birds and insects. Place brushpiles in woodlands and along wooded edges. Discarded Christmas trees can be used as a brushpile. See illustrations to the left.

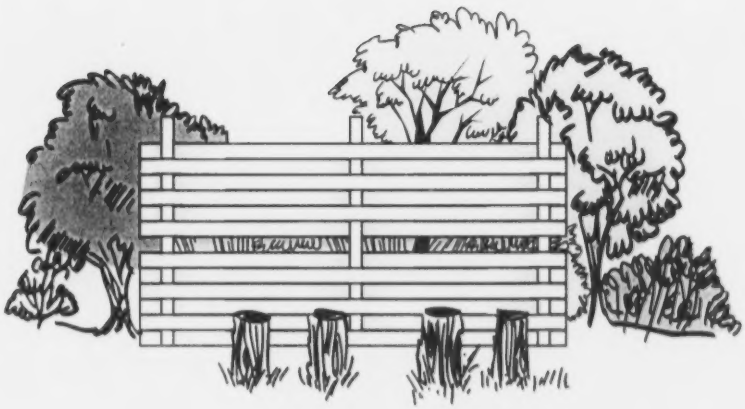
Water: If there is no wetland or pond, consider a way to provide water for wildlife. Half barrels or cement mixing troughs filled with water work well. If the soil has enough clay, simply dig a few shallow holes and let the rain fill them. Dripping water into a puddle is irresistible to birds. Check with a local library or nursery for directions on building a small, lined pond.

Nesting Boxes: Nesting boxes are a good habitat addition for cavity-nesting birds. Bat boxes and squirrel boxes can also be built. See chart on pages 121-122 for a list of specifications. A bluebird trail can be built by placing several nesting boxes at least 100 yards apart, preferably along a forest edge or in a meadow. Boxes must be placed on posts with predator guards. Boxes should be monitored and cleaned after each brood. Many birds may use bluebird boxes for nesting. All birds, except house sparrows and starlings, are protected by law.

Feeders: Place bird feeders near protective shrubs and trees to attract more birds. A feeder project should have some long-term benefit for the students and not be a one-time project.

Other Features

Signs: Identify projects with signs to help with community recognition. Signs will help offset concerns about the appearance of natural habitats.



Wildlife Observation Blind: A simple structure with a solid wooden wall with slats cut out at eye level will allow students to view wildlife on the other side. It should be placed in front of bird feeders, wetlands, in meadows or along thickets for closer observation of secretive wildlife. See diagram for basic design.

Trails: Trails should be an integral part of any project. Be sure to incorporate wheelchair access into the trail design. A nature trail could eventually wind throughout the entire schoolyard. Regularly mowed grass trails are easily maintained in sunny areas. Make the trails the same width as the mower. Wood chips are a good ground cover for wooded trails. Many tree maintenance companies will provide free wood chips.

Outdoor Seating: An area or several areas where class can be held outside or a child/group can go to complete a task or read/write in privacy. Picnic tables can be used for lunchtime and as work stations. Place in an area that is easy to access from school. Hillsides are a good place for a small amphitheater. See reference: *Thinking About Seating in Your School Grounds*, page 124.

Wildlife Tracking Box: A wooden box filled with mud or modeling clay and placed near water or a feeding area makes a good tracking box. Visiting animals will leave tracks which students can identify, make plaster castings of, write stories about, etc.

Composting: Large- or small-scale composting can be used to teach many lessons. Your local Cooperative Extension Service office or County Public Works office can provide information on different composting structures.

Landscaping: The typical foundation landscape around most schools consists of ornamental non-native plants. Designing a native plant landscape provides learning opportunities for children and adults. Native plant landscapes also give children a sense of place within their local environment. Contact a landscape architect with experience in native landscape design.

Gardens: Many types of gardens can be planted on schoolyards. Planned garden areas should be included in the school design. Considerations for gardens include:

- Make close to building (courtyards work well).
- Full sun is important.
- A nearby faucet is essential.
- Topsoil or loam soil should be placed in garden area (store topsoil if raised beds will be built at later time).
- Raised beds work very well to define areas which helps maintenance staff.
- Gardens should be accessible to children at all times.

Some types of gardens include:

- A native plant garden or arboretum.
- A butterfly/insect garden. Plants selected for their nectar and caterpillar food. Be sure to include several species that bloom when children are in school.
- Vegetable garden. Should be primarily early- and late-season vegetables so students can enjoy the harvest.
- Herb garden.
- Sensory garden. Plants selected for their aromatic, textural, visual or edible qualities.
- Berry patch. A patch of harvestable berries such as blackberries, raspberries, blueberries and huckleberries.

Art: There are many types of murals, blacktop diagrams, sculptures and other art-related projects that can be done to enhance the outdoor learning environment.

Playgrounds: Many good references are available for playground design. Check page 124 for a list.

Hills: One or a group of small hills can be constructed with excess soil. This seemingly strange feature can add to the diversity and enjoyment of playgrounds. An open or enclosed lookout tower can be built on top of a hill.

Shade: Plant shade trees throughout the site, especially near the playground. Arbors can be built to create shade. An open air cabana can provide shade.

Weather Station: A weather station is an excellent compliment to any outdoor learning area.

Geology Study Area: To teach about local geology, designate an area where samples of local rocks are kept.

Chapter 2

Forest Habitat Project

Teacher Section

Step 1 Complete background research

Step 2 Complete forest habitat survey, wildlife survey

Step 3 Determine growing conditions

Step 4 Determine the number of plants

Step 5 Select plants

Step 6 Make a planting map

Step 7 Have plan reviewed

Step 8 Review planting day checklist

Step 9 Carry out management and maintenance

Introduction

Overview

In this project, students research and make a plan to establish a small forest. The size does not matter. It can be done in a courtyard, on the corner of a city block or on an acre or more of land. A small project may be more appropriately called a woodland garden. This project is different from just planting trees. Methods outlined in this section take an ecological approach to planning a reforestation project. Students will research the dominant plant species in a nearby forest, then design a planting that mimics the nearby forest as closely as possible. By doing this, students will be establishing a forest community rather then just a random group of trees. Through this process, students will learn much about the forests in their community. Students will understand that a forest has many components. Good planning and a good management plan are the keys to a successful project.

How to begin

The first step is to decide what type of project to do. This will depend on the site conditions of your school grounds. All forest projects involve planting trees/shrubs and adding other forest features like decaying logs, leaf litter, brush piles and nesting boxes. A slight variation for this project is to plant only shrubs and small trees. This will develop into a shrub/scrub habitat. See the drawing on page 13.

Forest Projects

Existing Site	*What to Do*
Upland area: Lawn or bare ground	Plant a variety of trees and shrubs. Add other project features.
Streamside area: Lawn or bare ground	Plant a variety of trees and shrubs to create a streamside (riparian) forest. A 100-foot width is optimal, wider is better. However, any width is better than none. If the streambank is eroding, consult with a natural resource expert before proceeding. Add other habitat features.
Narrow strip of lawn or bare ground	Create a hedgerow by planting a variety of deciduous and evergreen trees and shrubs. Add other features.
Scattered trees on lawn	Fill in between existing plants with trees and shrubs. Add other features.
Wooded area with few understory plants	Find out the reason for the lack of understory plant (such as mowing or a fire). Plant shade-tolerant understory trees and shrubs. Make sure the area is not mowed. Add other habitat features.
Existing forest degraded by invasive, non-native plants	Seek advice from a natural resource expert on the possibility of removing the invasive plants and replacing with native species.

General information for all projects

After planting, do not mow around each plant. Let nature take its course or mulch the entire area with leaves or wood chips. Mulching will help control weeds and allow other plants to colonize, thereby helping the forest evolve more quickly. Wood chips or leaves can be put down on the project site before or after the planting. Free wood chips are often available from tree trimming companies. Free leaves are available from homeowners during the fall raking season. The best planting time is early spring or fall.

Estimated time for students to complete the project

The time needed will depend on the size of the project. Planning a 5,000-square-foot project should take students about six to eight hours of planning. Planting will take up to one school day depending on the size of the plants and the number of students involved. Students should have two to four months to research the project.

Resource team role

Professional foresters and other resource specialists can give guidance and helpful advice and review the students' work.

1. State or county forestry department
2. Universities: wildlife, ecology or forestry programs
3. Native plant nurseries
4. Nature centers
5. Botanical gardens
6. Local botanists

Additional project features

See pages 20-22 for a list of other project features that can be added to your habitat.

A fun and practical addition to your reforestation project is to build a perch where birds will land, leave droppings and help spread seeds to your site. Put up two posts and stretch a rope between the posts. Till the area underneath the rope. Birds will land and leave seeds with their droppings. Till another area equal in size without a perch. Students can compare plant colonization between the two areas.

Step 1
Complete background research

Students should read pages 34-35, *What is a forest?* An optional but valuable activity is for students to visit a nearby forest where they can observe and identify the different forest layers and features. In order to select appropriate species, students will need to know the dominant canopy trees, understory trees and shrubs in a nearby forest. They will use this information as a model from which to choose their species. As the group leader, you need to facilitate gathering this information. One option is to work with students on identifying species. Another option is to ask a local botanist/ forester for assistance. Your state forestry or natural heritage department may already have a list of common species found in the forest type for your area.

Materials
copies of pages 34, 35
List of dominant plants in nearby forest

Order nursery catalogs

Contact your local forester or natural resource agency for a list of native plant nurseries. Some states have their own nurseries. Call and order catalogs or have students call or write letters requesting catalogs.

Step 2
Complete forest habitat survey, wildlife survey

In this step students will go outside to the site and:

- Review the chart on page 37 to decide what the existing site conditions are and decide what type of action is needed.
- Use the forest habitat checklist on page 36 to decide what, if any, forest habitat features already exist.
- Make a list of recommendations for habitat improvement, page 38.

The *Wildlife Survey* is a generic method to sample the existing wildlife found on the project site. The purpose is to give students a base line from which to compare future surveys. The survey sheet is on page 17.

Materials
copies of pages 17, 36-38

Step 3
Determine growing conditions

Students will determine the amount of sunlight, soil texture and soil moisture. This will give them additional information to help pick plants that are appropriate for the site.

For the sunlight, students may need to develop a method to measure the light throughout the school day. A simple method is to draw the boundaries of the planting area on graph paper and have students go out each hour and mark on graph paper the line between sun and shade. This should help them make an informed decision.

When deciding how moist the site is, have students go out two to four days after a rainstorm. If the site is well drained, most of the moisture will be gone. If the site is poorly drained, then the site may still be wet and soggy. Mesic means medium and is in between dry and wet.

Many plants will grow in a range of soil textures. However, if the soil is very sandy or clayey, then be sure the species you select are adapted to these extreme soil conditions.

Materials
shovel
water bottle
copies of pages 39-41

Step 4
Determine the number of plants

In this step, students measure the length and width of the project site, then calculate the area in square feet. If the area is not a rectangle, they should develop a way to measure and approximate the area.

Next, students will figure out the number of plants to order. The variable in this part is the spacing between each plant. The recommended number for spacing is 10 feet. This number can be adjusted (if you want the plants closer, use a smaller number, for more space between plants, use a larger number). If there are already some trees and shrubs in the planting area, subtract these from the total number of plants ordered.

Materials
measuring wheel or tape measure
copies of page 42

Step 5
Select plants

Students will use lists of common plant species and nursery catalogs to select plants. Emphasize that they should use the guidelines given in the student section. Students should list their choices on the plant chart found on page 44.

Materials
list of common species found in nearby forests
(you need to gather this in advance)
nursery catalogs
copies of pages 43, 44

Step 6
Make a planting map

Students can now make a planting diagram. The directions in the student section should be clear. A sample planting map can be found on page 45.

Materials
copies of pages 45, 46

Step 7
Have plan reviewed

Students need to write a letter and send their plant lists and planting map to a natural resource person for review. Students should review the instructions for writing a letter. Contact the resource person before sending the letters.

Materials
copies of page 45

Order Plants

It is best to order plants several weeks or even months before the planting day. The nursery will then reserve the plants for your project. Delivery arrangements can be made later.

Step 8
Review planting day checklist

Planting time

The best planting time is early spring or fall.

General

- [ ] Invite parents and members of the community.
- [ ] Invite the local newspaper or TV station (information on writing a news release is included in the appendix on pages 105-106).
- [ ] Find at least one person to take photographs. Slides work best for archiving and presentations.

Plants

- [ ] Order plants several weeks before planting day and arrange for pick up or delivery.
- [ ] Have a shady, safe spot to store the plants until planting day.
- [ ] Keep plants watered.
- [ ] Make sure all the plants are labeled.

Materials

- [ ] Shovels, rakes, pick axes, hand trowels
- [ ] A method to water plants: hose, buckets, milk jugs
- [ ] Wheelbarrows
- [ ] Mulch
- [ ] Compost

Step 9
Carry out management and maintenance

It is very helpful to have a forester or botanist visit the planting site at least once a year to make recommendations.

- **Watering–** This is the *most important short-term maintenance task*. Trees and shrubs need to be watered at least during the first summer after planting, preferably for the first two summers.

- **Invasive exotic species—** This is the *most important long-term maintenance task*. Identify and remove invasive, exotic species as soon as possible. Contact a local plant specialist to help identify invasive plants.

- **Colonization by other plants—** Other plants will colonize the site. This is a natural process that will add to the diversity of your habitat. If the colonizing plants are not invasive, it is best to leave them alone.

- **Mowing—** After planting, do not mow around each plant. Let nature take its course, or mulch the entire area with leaves or wood chips.

- **Mulching—** Spread 2" to 3" of mulch around each tree. Mulch will help retain moisture and control weeds. Wood chips or leaves can be spread throughout the entire project site before or after the planting. Free wood chips are often available from tree trimming companies. Free leaves are available from homeowners during the fall raking season.

- **Coordination with maintenance—** It is essential to let the maintenance staff know where to mow and where not to mow. Unmowed areas should be marked with stakes or 4'x4' posts. The single biggest frustration of school habitat projects occurs when plants are accidently mowed.

Forest Habitat

Student Instructions

The goal of this project is to restore the forest habitat that may have grown on your school site before it was built. To do this, you will gather information or your teacher will provide information about the plants in other nearby forests. This will give you a model to use when planning your project. You may also be building or putting in place other features found in natural forests. Over time, the small trees you plant will grow and eventually turn into a forest with tall trees. The forest you create will provide habitat for many plants and animals.

What is a forest?

Step 1
Complete background research

A forest is a plant community dominated by trees. Forests also have many other parts that make them a unique place and good habitat for wildlife. Most forests can be divided into several layers.

Starting at the ground, the first layer is the *forest floor*. Decomposing leaves on the forest floor are called leaf litter. Leaf litter helps keep the soil rich and moist. Decaying logs and branches are also part of the forest floor. Beetles, millipedes, earthworms and many other insects live in the leaf litter. Salamanders live in the dark, moist spaces under logs. Shrews dig tunnels through the leaf litter. Many forests have vernal pools. Vernal pools are temporary pools of water that fill in the spring and dry out in the summer. They provide a place for salamanders and frogs to lay eggs. The forest floor provides protection to streams by absorbing rainwater and slowly releasing clean, filtered water into streams.

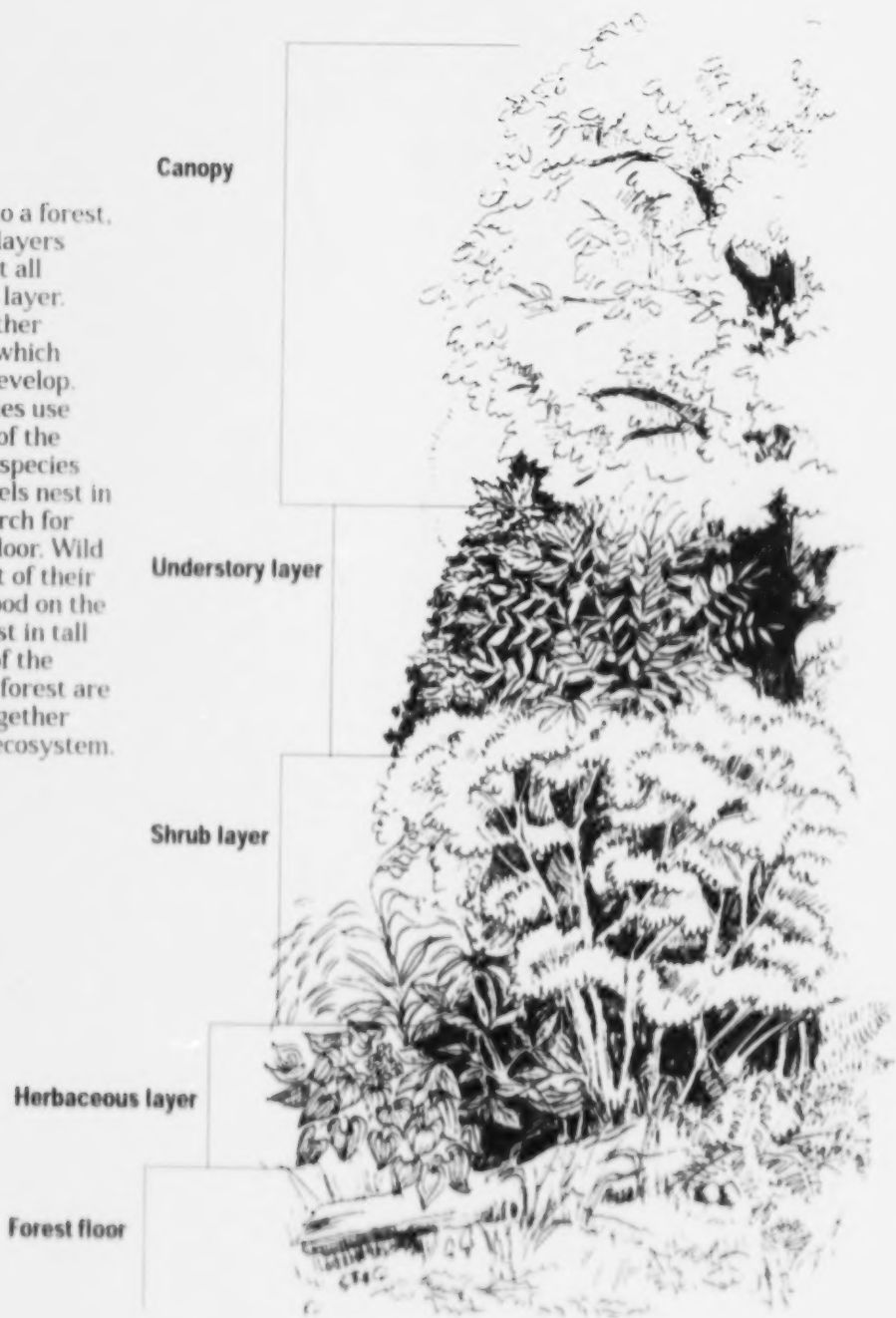
Right above the forest floor is the *herbaceous layer*. Herbaceous refers to plants with soft or fleshy stems. Plants in this layer include ferns and woodland wildflowers. Most of these plants are less than 3 feet tall. Most herbaceous plants die back in the winter and only the roots remain. As the soil begins to warm in the spring, herbaceous plants sprout and soon color the forest floor green. Many insects live in this layer. A small bird called an ovenbird builds its oven-shaped nest on the forest floor, hidden among the herbaceous plants.

Above the herbaceous layer is the *shrub layer*. The most abundant plants in this layer are shrubs and young trees. Shrubs are smaller than trees and sometimes have several main trunks sprouting from the same spot. Many birds, such as the wood thrush, build nests in this layer. Insects also are abundant in this layer.

The *understory layer* is above the shrub layer and consists of small trees and tall shrubs. Squirrels and insects occupy this layer. Many birds forage for insects and build nests here.

The *canopy* is the top layer in the forest and is made of the tallest trees. If you were in an airplane looking down, you would see only the canopy layer. Birds including the scarlet tanager and cerulean warbler nest high in the canopy. Many squirrels also nest in the canopy.

When you walk into a forest, you'll see that the layers blend together. Not all forests have every layer. Climate, soil and other factors determine which layers in a forest develop. Some wildlife species use only specific parts of the forest, while other species use several. Squirrels nest in the canopy and search for food on the forest floor. Wild turkeys spend most of their time foraging for food on the forest floor but roost in tall trees at night. All of the different parts of a forest are very important. Together they form a forest ecosystem.



Step 2
Complete forest habitat survey

In this step go to your project site and complete three items:

- Review the *Forest Projects* chart (page 37) and decide which best describes the existing site and what type of action is needed. Circle the one that best describes your site.
- Complete the *Forest habitat checklist*, below.
- Complete the *Forest project recommendation* section, page 38.

Forest habitat checklist

Place an X in the boxes that describe the forest features you already have on your site. Don't be discouraged if your site doesn't have any. Your challenge is to make a plan adding the features that are missing.

- ☐ Tall trees (forest canopy)
- ☐ Medium trees (understory)
- ☐ Shrubs
- ☐ Small herbaceous plants including woodland wildflowers and ferns
- ☐ Leaf litter
- ☐ Decaying logs
- ☐ Brush piles
- ☐ Standing dead trees or snags
- ☐ Vernal pools
- ☐ Nesting boxes

Forest Projects

Existing Site	*What to Do*
Upland area: Lawn or bare ground	Plant a variety of trees and shrubs. Add other project features.*
Streamside area: Lawn or bare ground	Plant a variety of trees and shrubs to create a streamside (riparian) forest. A 100-foot width is optimal, wider is better. However, any width is better than none. If the streambank is eroding, consult with a natural resource expert before proceeding. Add other habitat features.
Narrow strip of lawn or bare ground	Create a hedgerow by planting a variety of deciduous and evergreen trees and shrubs. Add other features.
Scattered trees on lawn	Fill in between existing plants with trees and shrubs. Add other features.
Wooded area with few understory plants	Find out reason for lack of understory plants (such as mowing or a fire). Plant shade-tolerant understory trees and shrubs. Make sure the area is not mowed. Add other habitat features.
Existing forest degraded by invasive, non-native plants	Seek advice from a natural resource expert on the possibility of removing the invasive plants and replacing with native species.

* *A list of other project features can be found on pages 20-22.*

Forest project recommendations

Make a list of the general plant types (for example, canopy trees) and other features you need to add to the site in order to create a forest habitat.

Some of the features like the canopy trees will take several years to grow.

Note: If the project site is in full sun, you won't be able to plant shade-loving herbaceous plants.

1.

2.

3.

4.

5.

6.

7.

8.

9.

Step 3
Determine growing conditions

In this step your task is to determine the three growing conditions in the planting area. Growing conditions include sunlight, soil texture and soil moisture. Completing this section should help you pick plants that will grow well in the conditions of your site. Go to your site and follow the directions for each growing condition.

Sunlight

Place an X in the box that best describes the sunlight on your site. If it is not obvious, figure out a method to measure the light throughout the day. Then place an X in the correct box.

☐ *Full sun* means the site is in direct sunlight for at least six hours a day.

☐ *Partial sun* means the site receives three to six hours of sunlight.

☐ *Shade* means the site receives less than three hours of direct sun.

Moisture

In this step you will decide if the soil is *dry, wet or mesic (average moisture)*. Dig a hole 8" deep. Take a handful of soil from the bottom of the hole. Read the descriptions below and check the box that best describes the soil moisture of the sample.

☐ Dry soil (very well drained): Soil does not feel wet. After rainstorms puddles don't remain for more than a few hours. In many cases dry soils are sandy. Dry soils are common on hillsides, especially those that face south.

☐ Mesic soil (medium drainage): This is average soil moisture—not dry and not wet. Soil may feel cool and damp but not soggy. Mesic soil moisture can be found in many different areas.

☐ Wet soil (poorly drained): The soil is wet and soggy. After rainstorms puddles remain for several days or weeks. In many cases wet soils have a high amount of clay. Wet soils are usually found in low-lying, flat areas.

Soil texture

In this part, determine the soil texture. Follow the directions on the soil texture chart on the next page. Place an X in the box that best describes the soil texture.

☐ Sand	☐ Clay loam	☐ Loamy sand	☐ Silty clay loam
☐ Sandy loam	☐ Sandy clay	☐ Loam	☐ Clay
☐ Silt loam	☐ Silty clay	☐ Sandy clay loam	

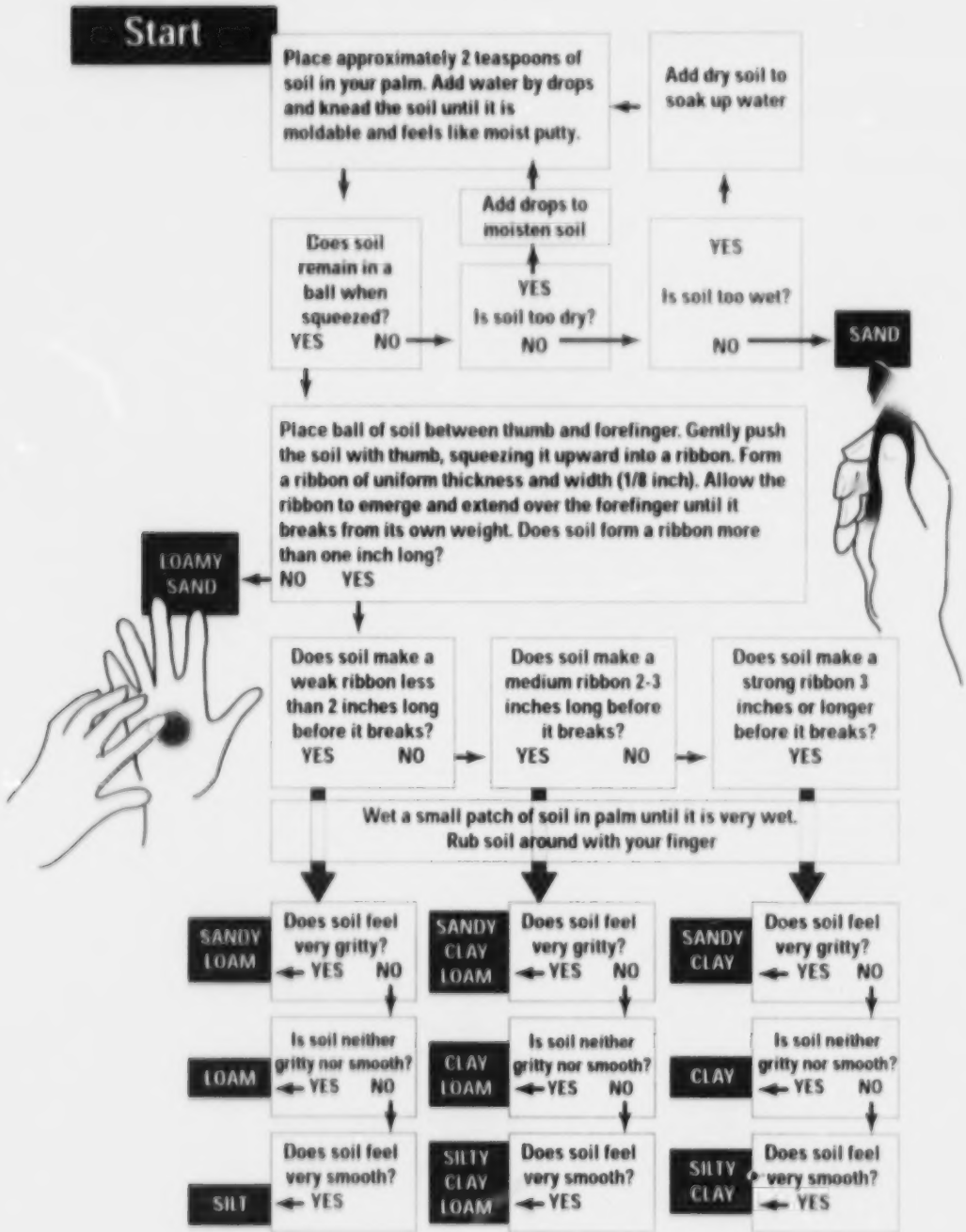
Summary of growing conditions

Sunlight _____

Moisture _____

Soil texture _____

Soil Texture Chart


Start
Place approximately 2 teaspoons of soil in your palm. Add water by drops and knead the soil until it is moldable and feels like moist putty.
Add dry soil to soak up water
Add drops to moisten soil
Does soil remain in a ball when squeezed? YES NO
YES Is soil too dry? NO
YES Is soil too wet? NO
SAND
Place ball of soil between thumb and forefinger. Gently push the soil with thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width (1/8 inch). Allow the ribbon to emerge and extend over the forefinger until it breaks from its own weight. Does soil form a ribbon more than one inch long? NO YES
LOAMY SAND
Does soil make a weak ribbon less than 2 inches long before it breaks? YES NO
Does soil make a medium ribbon 2-3 inches long before it breaks? YES NO
Does soil make a strong ribbon 3 inches or longer before it breaks? YES
Wet a small patch of soil in palm until it is very wet. Rub soil around with your finger
SANDY LOAM
Does soil feel very gritty? YES NO
LOAM
Is soil neither gritty nor smooth? YES NO
SILT
Does soil feel very smooth? YES
SANDY CLAY LOAM
Does soil feel very gritty? YES NO
CLAY LOAM
Is soil neither gritty nor smooth? YES NO
SILTY CLAY LOAM
Does soil feel very smooth? YES
SANDY CLAY
Does soil feel very gritty? YES NO
CLAY
Is soil neither gritty nor smooth? YES NO
SILTY CLAY
Does soil feel very smooth? YES

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Step 4
Determine the number of plants

In this step, your task is to figure out how many plants you need. Use Equation 1 to find the size of the planting area in square feet. Use Equation 2 to find the number of plants you need.

1. Finding the size of the planting area:

Area = Length (L) x Width (W)

Length (L) = _____ **in feet**

Width(W) = _____ **in feet**

Length _____ **x Width** _____ **= Area** _____ **in square feet**

2. Finding the number of plants:

N = $A \div D^2$

N = number of plants

A = area in square feet

D^2 = spacing between plants squared. For reforestation projects, use D = 10 ft.

A _____ $\div D^2$ _____ **= N** _____

Important

Approximately half of your plants should be large trees and half shrubs/small trees. Large trees will make up the canopy layer. Small trees will make up the understory layer and shrubs will make up the shrub layer of the forest.

C A U T I O N

Some plants are invasive. This means they can grow rapidly, spread and take over your habitat. A list of plants invasive to the mid-Atlantic region can be found on pages 132-133. To obtain a list for other regions, contact your state department of natural resources.

Step 5
Select plants

In this step your task is to select different species of trees and shrubs. The goal is to restore some of the plants that you think may have been there before the school was built. As you select the plants, list the choices on the plant chart (page 44). Be sure to fill in the plant name, water tolerance, light, cost and number of each. In the notes column explain why you selected the plant.

Keep the following in mind when selecting plants:

- Use only native plants.
- Use the information about plants in nearby forests as a model.
- Select four to seven species of large trees and four to seven species of shrubs/small trees.
- Choose plants for a variety of wildlife benefits.
- Consider planting some evergreens to provide year-round cover.
- Pick only plants adapted to the growing conditions in your area.
- Refer to nursery catalogs while selecting plants so that you choose plants that are available.
- Consider other unique features of the plant that interest you.

Plant Chart

Team name_____

Zone_____ Date_____

School name_____

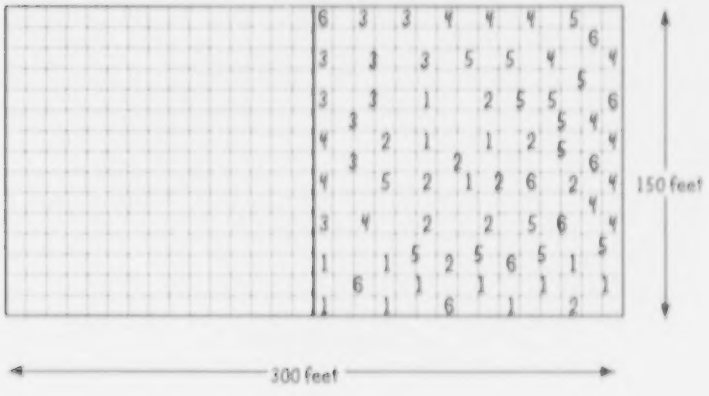
Plant Species - Common name	*Plant Species - Scientific name*	*water tolerance*	*sun*	*# of plants*	*cost of each*	*total cost*	*notes*

Step 6
Make a planting map

Your task in this step is to make a map that shows where each one of your plants will be planted. Make a key for each species and show where each will be planted. Also show where other habitat features like nesting boxes and brush piles will go. Look at the diagram below to help you. Notice how similar species are loosely grouped together.

Name Roy Hewitt
Team Number 3
Team Name Silly-pills

Key
1 = White Oak
2 = Flowering Dogwood
3 = American Holly
4 = Black Gum
5 = Staghorn Sumac
6 = Arrowood Viburnum



Step 7
Have plan reviewed

Your task in this step is to write a letter to a natural resource specialist asking them to review your work. All habitat specialists have their work reviewed by other experts. Use the guidelines below to help write your letter.

Writing a Letter

Your group has developed a plan for restoring a forest habitat. The choices you made about the kinds of plants were based on the plants that are in nearby forests, the growing conditions, wildlife value and other reasons. You have also made a map of your site showing where the plants will be planted. It is very important to get advice from an expert before you order the plants. Write a group letter to the forester or habitat specialist asking for a review of your plant list and planting map.

Before you begin to write, think about the plants you selected, the reasons you selected them and any questions you may have about the plants. Remember to thank the habitat specialist for reviewing your plan.

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Planting Map

Name_____

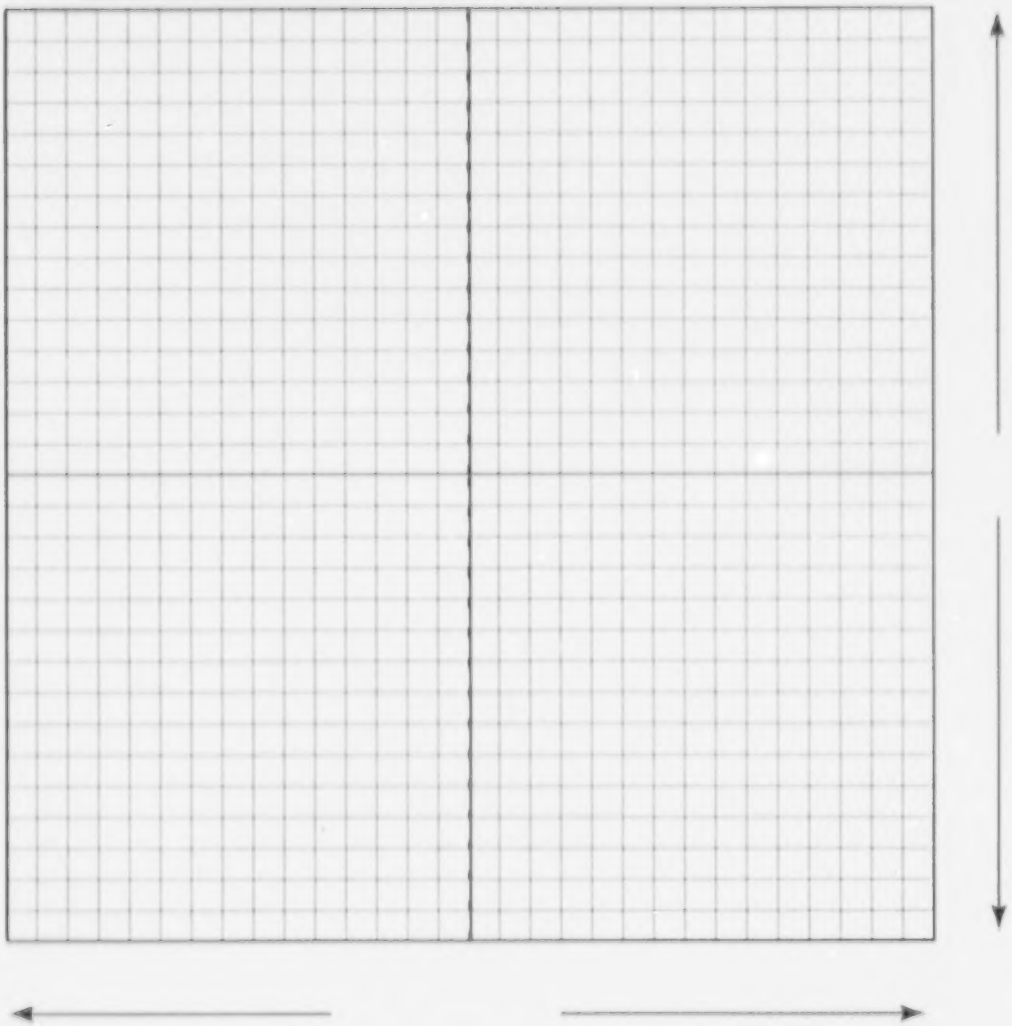
Team Number_____

Team Name_____

Zone_____

Key

1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =
10 =



Chapter 3

Wetland Habitat Project

Teacher Section

Step 1 Complete research

Step 2 Complete wetland site survey

Step 3 Complete wetland habitat survey, wildlife survey

Step 4 Determine growing conditions

Step 5 Determine number of plants

Step 6 Select plants

Step 7 Make a planting map

Step 8 Have plan reviewed

Step 9 Review planting day checklist

Step 10 Carry out management and maintenance

Introduction

Overview

Students will complete several steps that will lead to planting a wetland. All wetlands have three characteristics: water, saturated soil and plants adapted to wet conditions. Not all wetlands remain wet year-round. There are many different types of wetlands. They are usually classified by the amount and duration of water and by their plant community. Constructing a shallow marsh is the most popular type of school wetland project. Marshes are the wettest type of wetland and look like a large shallow puddle with plants, like cattails, growing out of the water. A school wetland can provide a fascinating outdoor laboratory for instruction across many disciplines.

How to begin

The starting point is different depending on the type of wetland project possible given the existing site conditions on the school grounds. The flow chart on page 50 gives examples of different existing school site conditions and should help you decide where you need to begin. *For any type of wetland project you should get advice from a wetland specialist before beginning.*

General types of wetland projects

Plant a wetland. Look for the following types of sites to plant a wetland:

• A pond. Possible project includes planting a marsh wetland in the shallow water area of the pond and planting an upland buffer next to the pond

• An area that is always wet and soggy. Possible area to plant a wet meadow, forested wetland or scrub/shrub wetland. A marsh can be built in these areas by digging out a shallow basin to hold more water.

• A stream that does not have an adjacent forested buffer. This is a good spot to plant a riparian or streamside wetland and plant an adjacent upland buffer.

Construct a wetland. Constructing a wetland will involve digging out a very shallow pond or building a small dam to trap water. The ideal site to construct a wetland has three characteristics:

1. A source of water:
   • A spring or seep
   • Rainwater from the school roof
   • Rainwater from the parking lot

- A spot that stays wet and muddy
- Ditches
- Stormdrains or grates
- Pipes carrying stormwater
- Stormwater management basins

2. Flat ground where a shallow pond can be dug out.

3. Clayey soil that will hold the water.

Estimated time for students to complete the project

Depending on the size and scope of the project, students will need eight to 16 hours to complete the steps that lead up to *planting the wetland*. At least one full day should be dedicated to the planting. It is best for students to begin planning in the fall or early winter and work toward a spring planting day. Allow six to 12 months to *plan and construct* a wetland. This can take longer depending on several factors.

Resource team role

To plan and construct a wetland, a team of teachers, community members and a wetland specialist should be assembled. The team should guide and advise students, and help with technical, administrative and logistical issues.

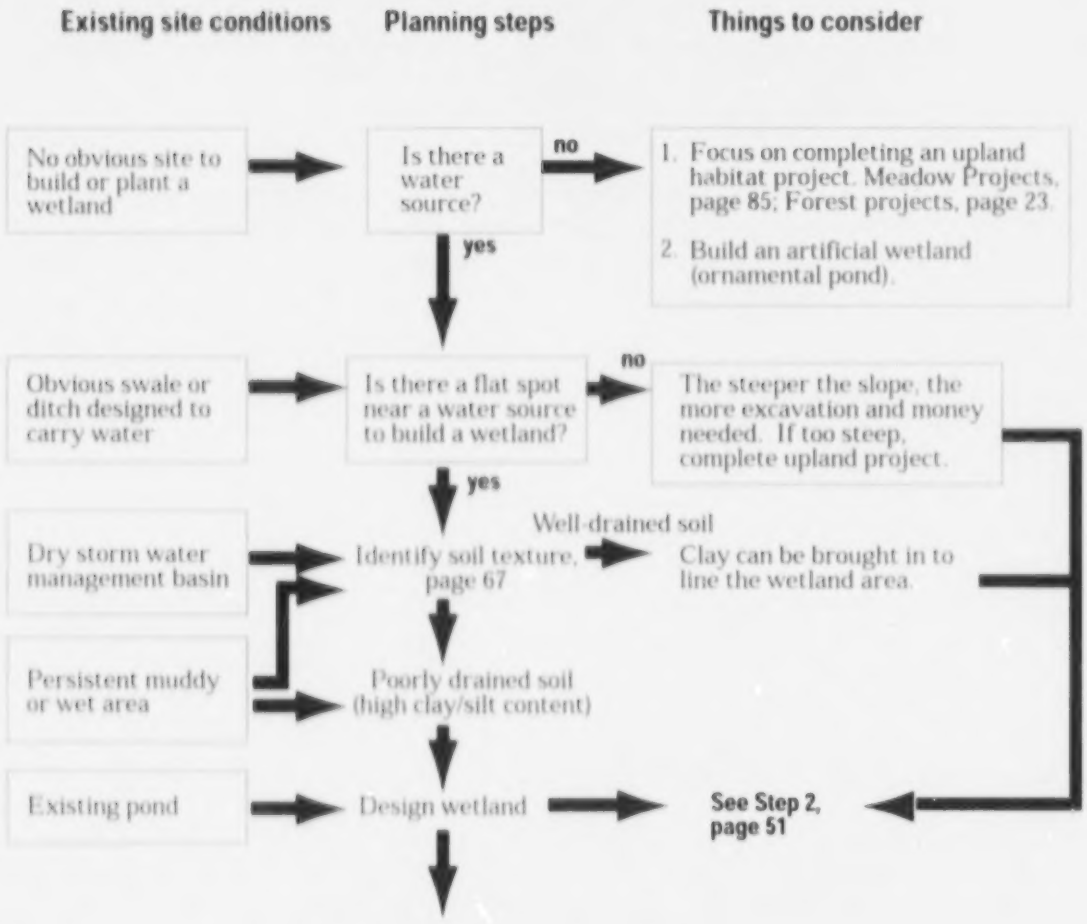
Sources of wetland expertise

- Natural Resource Conservation Service and Soil Conservation Districts: Federal and local employees who provide assistance to landowners. They have expertise in pond construction and expertise on soils.
- U.S. Fish and Wildlife Service: The federal agency that is involved with many wildlife and habitat issues. Most states have an office. They have expertise in wetland habitat design and construction.
- State natural resource agencies: Many state agencies have a wetland section.
- Wetland consulting firms. These businesses have expertise in wetland design and construction.
- Universities. Contact engineering or ecology professors
- Local public works departments
- Engineering firms

Additional project features

See pages 20-22 in the *Getting Started* section for additional project features.

Wetland Planning Chart


Existing site conditions
Planning steps
Things to consider
No obvious site to build or plant a wetland
Is there a water source?
no
1. Focus on completing an upland habitat project. Meadow Projects, page 85; Forest projects, page 23.
2. Build an artificial wetland (ornamental pond).
yes
Obvious swale or ditch designed to carry water
Is there a flat spot near a water source to build a wetland?
no
The steeper the slope, the more excavation and money needed. If too steep, complete upland project.
yes
Well-drained soil
Dry storm water management basin
Identify soil texture, page 67
Clay can be brought in to line the wetland area.
Persistent muddy or wet area
Poorly drained soil (high clay/silt content)
Existing pond
Design wetland
See Step 2, page 51

Students begin planning the wetland planting beginning with Step 4 on page 72.

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Step 1
Complete background research

As the teachers and planning team are working on finding a site, obtaining administrative approval, and working on design and construction logistics, students can be researching and learning more about wetlands. There is a short introductory reading in the student section. Additional information about specific wetland types may be found in the back of the student section. If you have the time, it is very helpful for students to visit a nearby wetland to collect data and help them visualize what they will be planting or constructing.

Materials
copies of "What are Wetlands, Why Should We Care?" page 64

Step 2
Complete wetland site survey

Before students complete this task, ask a wetland expert to work with you and decide if and where you could plant or construct a wetland. If the specialist says it is not feasible, then there is no sense in having the students continue with the project. If it is feasible, then the students should complete this step. By completing this step, students will be involved from the very beginning and therefore will take ownership of the project.

After the students come up with their recommendations, explain that you have met with a wetland expert. Explain to them why the wetland expert picked a certain site for the project. Compare and contrast the expert's recommendations with the students' recommendations.

Caution. The most common mistake students make when looking for a site to construct or plant a wetland is to identify a natural stream or wetland. These natural areas are probably already good habitat. The main challenge is to find an area that is not a good habitat, such as a lawn or a pond without a wetland edge, and change these areas into better habitat. Students may be able to do minor habitat enhancements to natural wetlands. These would include putting up nesting boxes or building brush piles, trails and boardwalks.

Materials
shovels
water bottle (to moisten soil)
clipboards
copies of pages 65-68

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Wetland design

Now you need to design the wetland. The design includes the size, shape, depth and slopes. Since each school site is unique and offers different opportunities and limitations, a wetland expert should be ultimately responsible for the design. Students can complete a concept design (sketch). Ask the wetland expert to design the biggest and best wetland, given the limitations of the site. Use the following information to provide guidance for working with an expert.

General information

The most important thing to communicate is that you want to build a wetland as opposed to a pond. Most wetlands are less than 2 feet deep. Pages 79-84 of the student resource section describes several different wetland types. A shallow marsh is the most common type of wetland that schools build. The diversity of plant and aquatic animal life found in marshes offers the greatest potential for instructional use. Some sites will allow more than one wetland type to be constructed in the same area.

Size

Building the largest wetland possible, given the limitations of the site, should be the goal. Too often schools build a small wetland in areas where a larger project is possible. A larger wetland will allow students more opportunities for investigation and discovery without standing on top of each other. A good size is 1,500 square feet or larger. However, space limitations will dictate the size of the project. Creating several smaller wetland pockets with upland between is a good option.

Shape

An irregular shape is best as it creates a more natural look with more nooks and crannies that provide good habitat. Irregularly shaped wetlands are more interesting for exploration. The bottom should be lumpy and uneven to create diversity. Hummocks, small islands that project out of the water, are an excellent feature to include. Different species of plants will spread and colonize different areas of the wetland based on small differences in water depth.

Depth

For shallow marshes, at least half of the wetland should have less than 6" of standing water depth. The saturated upland-wetland edge should be as wide as possible. A great diversity of wetland plants grow well in an area that remains saturated and only temporarily floods.

Slopes

For easy access and safety, the upland area leading down to the wetland and the bottom contour of the wetland should be very gradually sloped. A 5:1 slope or gentler is ideal.

Liners

If the soil in the proposed wetland area is well drained, 4" to 5" of clay soil can be used to line the site and create poorly drained soils. If clay is available, it is a much better to use clay than a rubber liner. Clay will not puncture or degrade like rubber, it is cheaper (if there is a nearby source), and it creates a much more natural wetland. If a rubber liner is the only option, 8" to 10" of soil should be placed on top of the liner. Wetland plants can then be planted directly into the soil. Soil is an integral part of any wetland system. Many aquatic invertebrates live in and on the soil substrate. Some amphibians and reptiles hibernate in the mud under wetlands.

Wetland construction

The person who designs the wetland or another specialist should be on hand to supervise construction. The construction supervisor will need to communicate very clearly with the equipment operator as many operators are more familiar with digging ponds than creating wetlands.

Conserving topsoil

Rototill or disc the footprint of the area being excavated for the wetland. Remove the top 4" to 6" of topsoil and set this aside. Complete the excavation, then spread the topsoil layer across the bottom of the wetland. Plants will grow much better in topsoil. Topsoil has important organic matter that provides the fuel for the small organisms at the base of the food chain. The reason for rototilling is that the sod would otherwise come up in large mats that will be nearly impossible to spread. The rototilling or discing can be done several days before the excavation.

Erosion control

Be sure to purchase silt fence and/or erosion control fabric before the construction day. The erosion control fabric should be used in spillways or swales where moving water could erode soil. Mats of sod can be scraped off the excavation site and used in place of erosion control fabric. Wetland vegetation should be planted for long-term erosion control.

Liners

If a clay liner is used, the clay should be kept moist so it is easy to spread and not allowed to dry out after construction. From six to 8 inches of topsoil or loamy soil should be spread on top of the clay. This will provide a good substrate for the roots of the wetland plants. You will need to adjust the depth of excavation to allow for the clay liner and soil on top of the liner.

Step 3
Complete wetland habitat survey, wildlife survey

Optional step depending on the existing conditions.

The *Wetland habitat survey* (pages 69-70) is used if you have a pond or degraded wetland you want to improve for better habitat. This survey will help students define existing habitat conditions and determine what kind of habitat improvements are possible. The student recommendations for habitat improvement should be primarily focused on native plants. If the site already has a diversity of native plants, then the opportunity for habitat improvement should focus on building nesting boxes, brush piles and other project features. A list of these can be found on pages 20-22.

An optional but important step is to have students complete a *Wildlife Survey*. This can be found on page 71.

Materials
copies of pages 69-71
clip boards

Order wetland nursery catalogs

optional for students

You will need to buy your plants from a native wetland plant nursery. A wetland expert, forester, member of a native plant society, or a biologist from a state natural resource agency or the U.S. Fish and Wildlife Service should be able to help locate a *native wetland plant nursery*. Call for a catalog or have students write letters requesting a catalog.

Make a design to help organize the planting

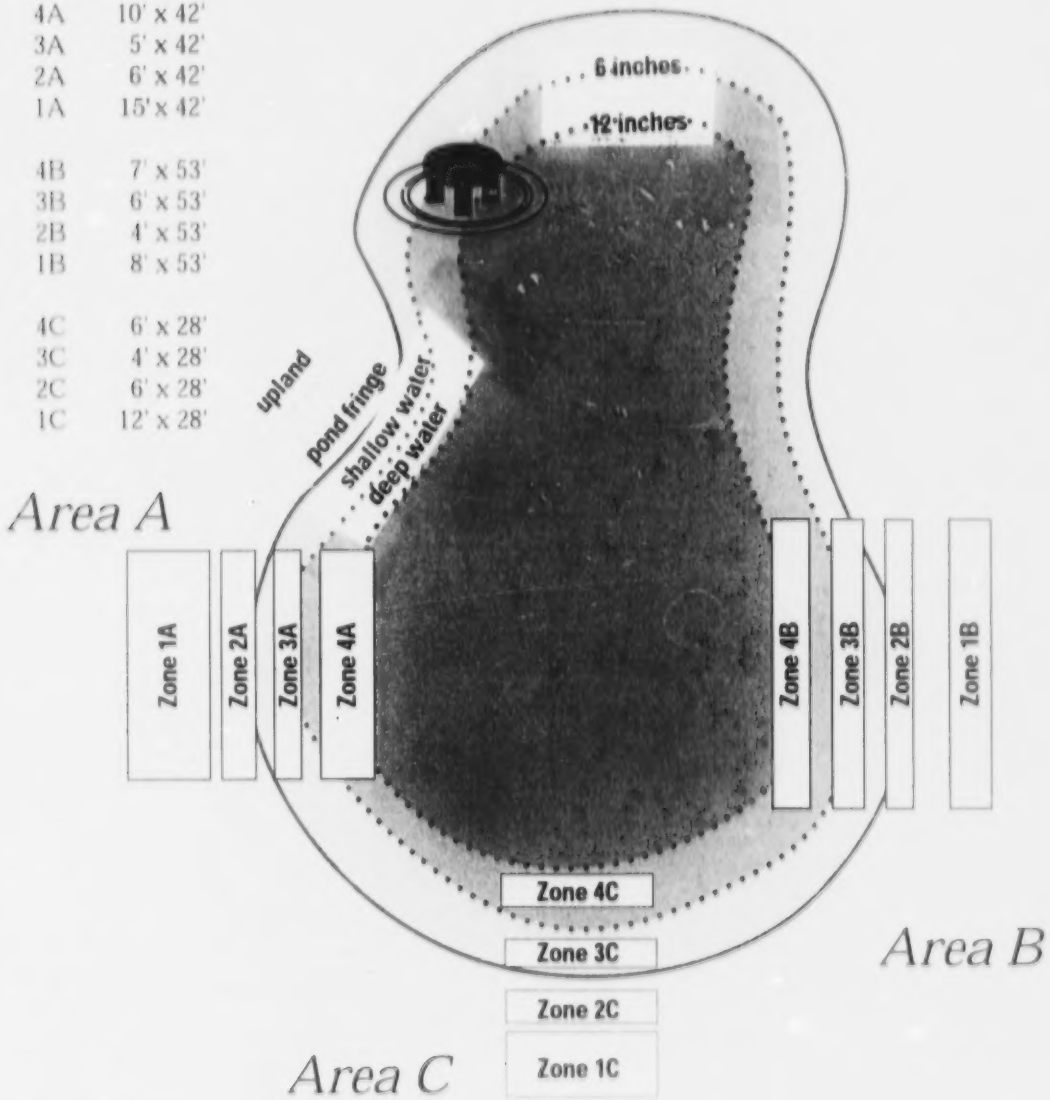
optional for students

Now you need to make a design similar to the example for Hollywood Elementary School on the next page. Doing this will help you organize the planting into manageable sections. Your wetland expert can help with this. Notice in the Hollywood example how each planting area is divided into four zones based on moisture. The design does not have to be as fancy as the Hollywood example as long as you have approximate sizes of the four planting zones. Not every wetland will have four planting zones. If your wetland is not constructed yet, use a scale drawing of the proposed wetland, draw in the planting zones, then measure the zones on the scale drawing. Now students should be divided up and assigned a zone or portion of a zone.

An optional task is to have students make an observational drawing of their zone or the entire project area.

Site:
Hollywood Elementary School
Wetland Planting Area

Zone	Size
4A	10' x 42'
3A	5' x 42'
2A	6' x 42'
1A	15' x 42'
4B	7' x 53'
3B	6' x 53'
2B	4' x 53'
1B	8' x 53'
4C	6' x 28'
3C	4' x 28'
2C	6' x 28'
1C	12' x 28'



		Moisture	Plant types
Zone 4	Deep wetland	flooded 6"to12"	herbaceous plants
Zone 3	Shallow wetland	flooded 0"to 6"	herbaceous plants
Zone 2	Wetland edge	wet to moist	shrubs & herbaceous plants
Zone 1	Upland	well drained	shrubs & small trees

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Step 4
Determine growing conditions

Students need to be familiar with the light and moisture conditions of their zone so they can select appropriate plants. If the amount of sunlight is not obvious, students will need to set up a simple experiment to measure sunlight throughout the day. The moisture conditions were roughly figured out when the area was divided into different zones. The soil conditions were omitted since many native wetland plants grow in a wide range of soil conditions.

materials
copies of page 72

Step 5
Determine the number of plants

Divide the students into teams and assign each team to a planting zone. If there are more student teams than planting zones, divide the zones into smaller units, or have two teams work on the same area and combine the results.

A fifth zone for water more than 12" deep may be added since several species of emergent wetland plants will grow in water more than 12" deep. Also, SAV (submerged aquatic vegetation) can be planted in deeper areas where permanent pools will remain.

Students should complete the calculation to figure out how many plants they need for their planting zone. Notice that different types of plants are used in different zones (see chart on page 73). The most confusing part here is that zone B uses both herbaceous plants and small trees and shrubs. Do the calculation using D= 2,' then add one shrub for each 20 to 25 herbaceous plants (refer to page 73 showing the calculation).

The number of plants that the students come up with is just a guideline for ordering plants. After doing the calculation, you may have too many herbaceous plants than you have the time to plant. Fifth graders can plant about 100 to 200 herbaceous plants and 20 to 30 shrubs in a school day assuming they will work in 45- to 60-minute shifts throughout a school day with different students in each shift. This is only a guideline and will change according to the amount of adult assistance, type of nursery stock ordered and the soil conditions. Planting in

hard clay soil will take much longer. Adjust the number of plants you order according to the budget and what you will be able to plant. Some of the herbaceous plants spread rapidly, therefore you won't need to order as many. It is better to order fewer plants, take your time and follow correct planting procedures.

materials
copies of page 73

Step 6
Select plants

Students can now choose the plants for their zone. *We strongly recommend using only plants native to your area.* Buying plants from a native plant wetland nursery is a good way to ensure native plants are used. An example of Steps 6 and 7 can be found on page 58.

materials
copies of pages 74, 75

Step 7
Make a planting map

Students can now make a planting diagram. The directions in the student section should be clear.

materials
copies of pages 58, 76, 77

Step 8
Have plan reviewed

Students need to write a letter and send their plant lists and planting map to a wetland expert for review. Have them review the instructions for writing a letter. Contact the wetland expert before sending the letters.

materials
copies of page 77

Order Plants

It is best to order plants several weeks before the planting day. Again, don't order more plants than the students will be able to plant.

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Name Jerry Green **Team Number** 4 **Zone** 1C

Team name Slaphappy

Plant species	Water tolerance	Sun	Number of plants needed	Price each	Total	Notes
		○				Blooms all year
Blue Flag Iris	0-6 in.	◑	15 Blue Flag Irises	.85	$12.75	Near mid tide
Sweet Flag	0-2 ft.	◑	14 Sweet Flags	.65	$9.10	blooms all year
Lizard's Tail	1 ft.	◑	14 Lizard's Tails	.90	$2.60	Near mid tide
Spatterdock	1-3 ft.	◑	14 Spatterdocks	$1.50	$21.00	Spreads slowly
Duck Potato	0-2 ft.	◑	14 Duck Potatoes	.65	$9.10	Spreads rapidly blooms all year

Name Jenny Green

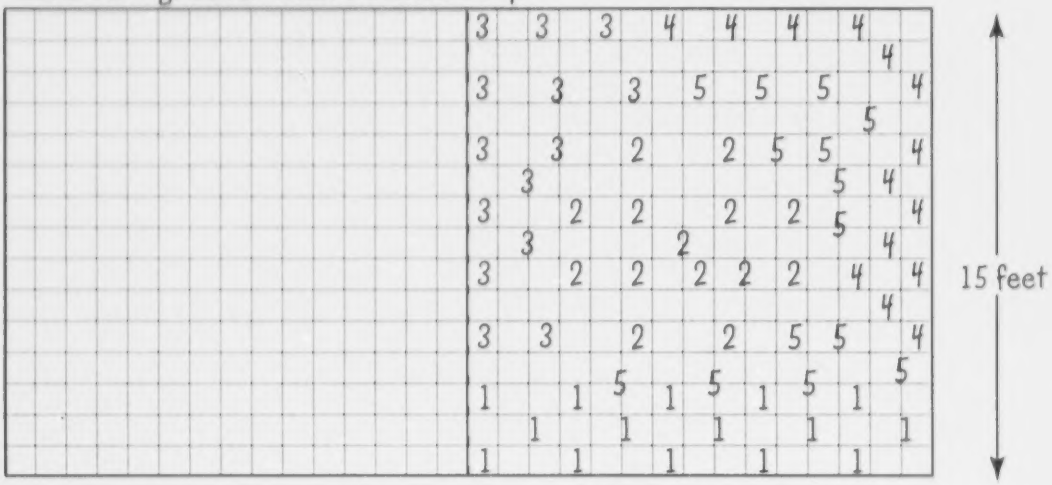
Team Number 4

Team Name Slaphappy

Zone 1C = greater than 6 inches deep

Key

1 = Blue Flag Iris
2 = Sweet Flag
3 = Lizard's Tail
4 = Spatterdock
5 = Duck Potato



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Step 9
Review planting day checklist

General

- [ ] Water in the wetland needs to by drawn down below the level where students will be planting. *This is very important!*
- [ ] If necessary, remove all domestic or Canada geese. *They will* pull out herbaceous wetland plants. Contact a wildlife agency for assistance.
- [ ] Invite members of the community.
- [ ] Invite the local newspaper or TV station. See pages 105-106 for information on writing news releases.
- [ ] Find at least one person to take photographs. Slides work best for archiving and for giving presentations.

Plants

- [ ] Order plants several weeks before planting day and arrange for pick up or delivery.
- [ ] Have a shady, safe place to store the plants until planting day.
- [ ] Keep plants watered.

Materials

- [ ] Shovels, rakes, pick axes, hand trowels
- [ ] A method to water plants immediately after planting: hoses, buckets, empty milk jugs for watering
- [ ] Wheelbarrows
- [ ] Mulch
- [ ] Compost

Step 10
Carry out management and maintenance

Monitoring and observing changes over time is the key to making management decisions. It is very helpful to work with a wetland expert or botanist to provide guidance. The following are some general maintenance guidelines.

Removing invasive exotic species

This is your number one concern. Remove invasive exotic species as soon as they are identified. A wetland expert, botanist or naturalist should visit your site one to two times a year to help identify and provide advice on managing invasive exotic plants. For more information about invasive exotic plants, see pages 132-133.

Colonization by other plants

Other plants will colonize the site. This is a natural process that will add to the diversity of your habitat. Some may compete with your plants. If the colonizing plants are not invasive, it is best to leave them alone.

Adding more plants

Some wetland plants spread rapidly; therefore, it may not be necessary to add plants. If you need to add plants, wait until late in the spring after dormant plants have come up so you don't step on and crush the dormant plants.

Water

Upland plants need to be watered at least during the first summer after planting. Refer to page 31 of the Forest section for additional maintenance tips for upland plants.

Coordination with maintenance staff

It is essential to let the maintenance staff know where to mow and where not to mow. Unmowed areas should be marked with stakes and/or a diagram. The single biggest frustration for school habitat projects occurs when new plants are accidently mowed.

Water fluctuation

Many plants are adapted to natural fluctuations in water levels. However, if the water floods too deep or too often, or dries out too much, then certain plants may not survive. Therefore, it is important to keep track of which species survive better than others. More often than not, too much water is the cause of plants not surviving. There are other reasons for plants dying, such as poor planting technique or poor nursery stock, but water levels play a major role in plant survival.

Siltation

Depending on several factors, the depth of the wetland may become more shallow over time through siltation. This is a natural process and can be accelerated by poor land use in the drainage area. The plant community may change as the depth of water changes. Eventually, you may need to remove silt or let the wetland progress to a shallower basin.

Adding animal species

One of the most common questions about wetland projects is "Should I add fish, frogs or turtles?" There is no need to add your own frogs or turtles (unless your site is in an enclosed area) as they will find their way to your wetland if it meets their habitat needs. Many amphibian species only use wetlands to lay eggs so you may not see the adults. Other species are more water dependent and will stay around longer. Adding fish is a little different since it is unlikely fish will colonize your site unless it is connected to a stream or river system. Since fish eat tadpoles, many species of amphibians will only lay their eggs in wetlands that do not have fish. Fish require deeper water to survive winter freezes and summer heat. Since there is a worldwide decline in many amphibian species, it is usually recommended not to add fish unless it meets a specific educational goal.

Wetland Habitat Project

Student Instructions

Your class has decided to do a wetland habitat project. There are many steps in this project. All of the steps will lead to your class activity of planting a wetland. Building and planting a shallow marsh is the most popular type of school wetland project. When the project is completed, it should look like a very shallow pond with many kinds of wetland plants growing in and around it. The plants will provide food, shelter and space for wildlife.

What Are Wetlands, Why Should We Care?

Step 1
Complete background research

Wetlands are basically wet lands. Wetlands include swamps, bogs and marshes. All wetlands have three things in common: water, water-logged soil and plants adapted to a wet environment. Most wetlands are covered with shallow water at least part of the year. Some wetlands rarely have standing water.

Wetlands are very important. They are home to many different species of wildlife. Wetlands and wetland plants provide wildlife with food, water, shelter and hiding places. They prevent floods by slowing down rainwater running off the land. They also filter pollutants including toxins, excess nutrients and sediment (soil in the runoff water).

Unfortunately, we have only recently begun to understand the importance of wetlands. In the past 50 years, the Chesapeake Bay watershed has lost many acres of valuable wetlands. At least 50 percent of the land that was once wetlands has disappeared. Most of the wetlands have been lost to the development of homes, roads, farms, stores and other buildings. New laws are helping to protect wetlands. Creating wetlands and planting wetland plants can help replace some of the wetlands that have disappeared.

Step 2
Complete wetland site survey

In this step, your task is to:

- Walk around your schoolyard and identify two possible sites to *plant or construct a wetland.* The best spot to plant or construct a wetland is in an area that is not already a good habitat. This means you would not want to cut down trees or dam up a natural stream to build a wetland. Use the checklists to keep track of what you find.
- Write the information about the two sites on the Wetland Site Evaluation Chart, page 68.
- Make your decision about which site would be best.

Checklist to plant a wetland

Place a check in the box if you find one of the following types of areas:

☐ A pond. Possible project includes planting a marsh wetland in the shallow water area of the pond and an upland buffer of shrubs and small trees next to the pond.

☐ An area that is always wet and soggy. Possible area to plant a wet meadow, forested wetland or scrub/shrub wetland. A marsh can be built in these areas by digging out a shallow basin to hold more water.

☐ A stream that does not have a forested buffer next to it. This is a good spot to plant a streamside or riparian wetland and plant an adjacent upland forested buffer.

Note: If you found a site to plant a wetland, then refer to planting instructions. If you want to construct a wetland, continue:

Checklist to construct a wetland

Constructing a wetland will involve digging out a very shallow pond or building a small dam to trap water. First you need to find a good area to do this. Three features are necessary to construct a wetland. Your task is to find an area on your schoolyard that has these three features.

- A *water* source
- Flat *ground* near the water source where a shallow pond can be dug out
- Clayey *soil* that will hold the water.

Factors for contructing a wetland

When you go outside to look:

First —
Find a water source. Use the checklist to keep track of the water sources you found.

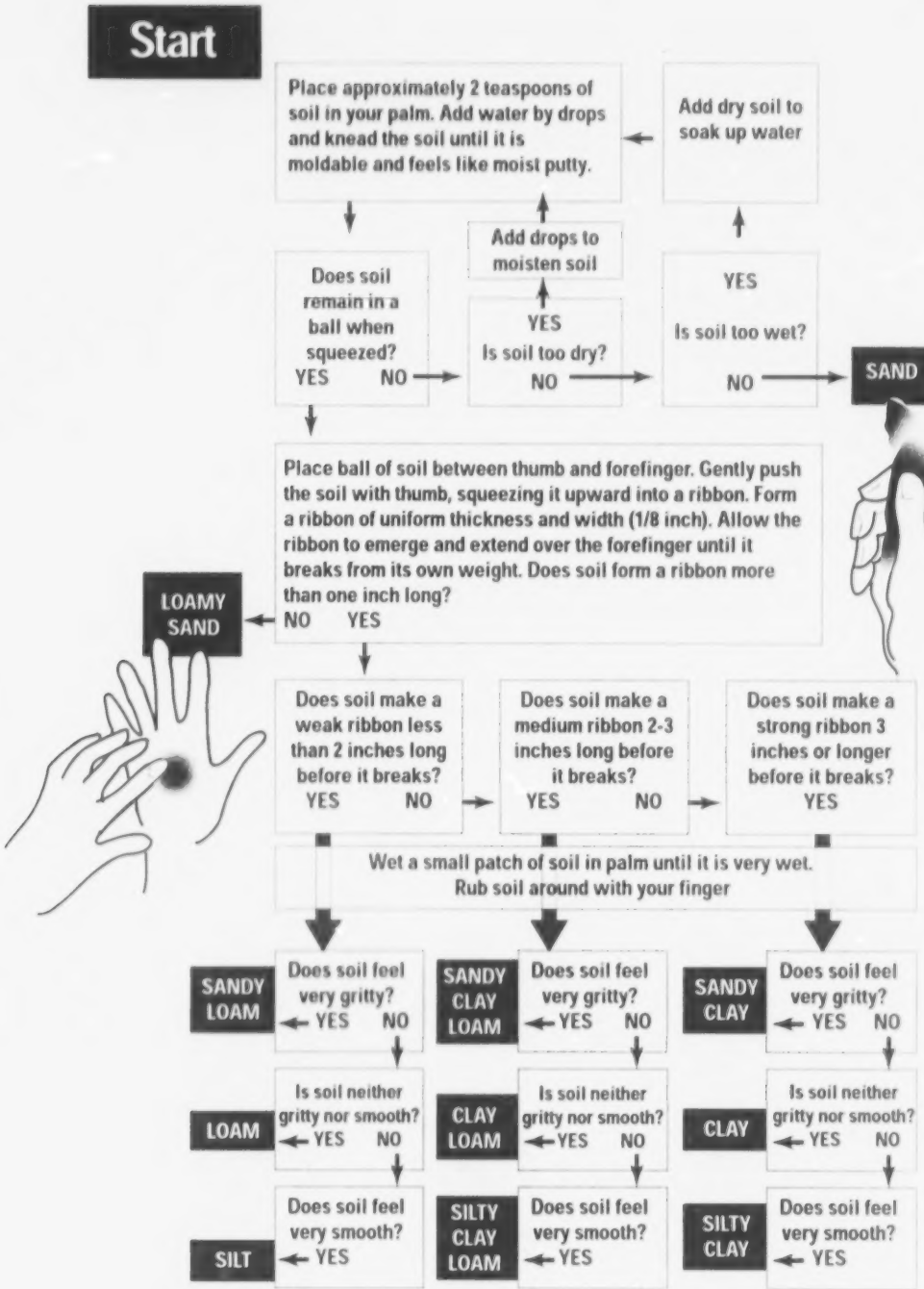
Second —
Look for flat ground near the water sources. Circle the water sources that also have flat ground nearby.

Third —
Pick the two best water sources with flat ground and examine the soil. You will be examining the soil texture. Soil texture refers to the amount of sand, silt and clay particles that make up the soil. Soils with more clay and silt drain slowly and are good for building wetlands. Sandy soils drain quicker and are not good for building wetlands. Dig a hole at least one foot deep and take a small handful of soil. Carefully follow the directions on the Soil Texture Chart (page 67) and decide what type of soil you have.

Water sources	Slope of ground	Type of soil
		Suitable for building wetlands
☐ A spring or water seeping out of the ground	**Good**	☐ Sandy clay loam
	slope of ground	☐ Clay loam
☐ Rain water from the school roof		☐ Silty clay loam
		☐ Sandy clay
☐ A spot that stays wet and muddy	**Fair**	☐ Silty clay
	slope of ground	☐ Clay
☐ Ditches or gullies		
☐ Pipes under roads or parking lots		*Unsuitable for building wetlands*
		☐ Sand
☐ Stormwater management basins	**Poor**	☐ Loamy Sand
	slope of ground	☐ Sandy loam
☐ Other		☐ Loam
☐ _____		☐ Silt loam
☐ _____		
☐ _____		
☐ _____		

Note: If your soil is not good for building a wetland do not be discouraged. The site can be lined with 4" to 5" of clayey soil. The clay liner will prevent water from seeping, thereby creating a wetland.

Soil Texture Chart


Start
Place approximately 2 teaspoons of soil in your palm. Add water by drops and knead the soil until it is moldable and feels like moist putty.
Add dry soil to soak up water
Add drops to moisten soil
Does soil remain in a ball when squeezed?
YES NO
YES
Is soil too dry?
NO
YES
Is soil too wet?
NO
SAND
Place ball of soil between thumb and forefinger. Gently push the soil with thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width (1/8 inch). Allow the ribbon to emerge and extend over the forefinger until it breaks from its own weight. Does soil form a ribbon more than one inch long?
NO YES
LOAMY SAND
Does soil make a weak ribbon less than 2 inches long before it breaks?
YES NO
Does soil make a medium ribbon 2-3 inches long before it breaks?
YES NO
Does soil make a strong ribbon 3 inches or longer before it breaks?
YES
Wet a small patch of soil in palm until it is very wet. Rub soil around with your finger
SANDY LOAM
Does soil feel very gritty?
YES NO
LOAM
Is soil neither gritty nor smooth?
YES NO
SILT
Does soil feel very smooth?
YES
SANDY CLAY LOAM
Does soil feel very gritty?
YES NO
CLAY LOAM
Is soil neither gritty nor smooth?
YES NO
SILTY CLAY LOAM
Does soil feel very smooth?
YES
SANDY CLAY
Does soil feel very gritty?
YES NO
CLAY
Is soil neither gritty nor smooth?
YES NO
SILTY CLAY
Does soil feel very smooth?
YES

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Wetland Site Evaluation Chart

Your teacher will invite a wetland expert to review your decision. The expert will help you understand which site would be the best to construct a wetland.

Use the information you gathered from your wetland field checklist, page 66, to complete the chart. The chart will help you evaluate which site is the best for your wetland project.

In the first column, describe site A and site B.
In columns two through four (Wetland site features), place a check in the box if the feature is good for building a wetland.

In the last column describe the type of plants that are growing on the site.

	Wetland site features			
Wetland site	**Water source**	**Slope**	**Soil texture**	**Existing plants**
A.				
B.				

Write down which site you think would be better for building a wetland and list three reasons why.

1.

2.

3

Step 3
Complete wetland habitat survey, wildlife survey

Your task is to examine the existing habitat in your wetland area. Go outside to the wetland area. Read through the survey and score each question. Estimate a score for the parts that are difficult.

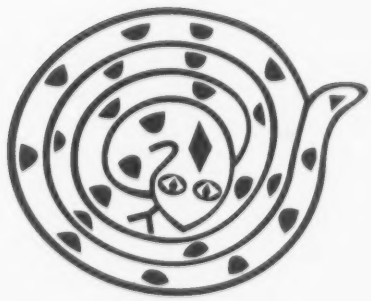
Points possible	Points scored	
		Water
		Water is important. Many plants and animals live in water. Animals that live on land need water to drink. Some land animals like many frogs and salamanders lay their eggs in water.
8 to 10	_____	Is there water present all year?
1 to 7	_____	Is there water present only part of the year?
0	_____	Does water remain for only a few days?
		Shelter/Space
		All types of wildlife need a space to live and shelter from weather and predators. Plants provide most of the shelter and space in an animal's habitat. Other habitat features that provide shelter/space include brush piles, dead trees, rotting logs and nesting boxes.
		The shallow part of the wetland that is less then 2' deep is very important for growing wetland plants. In this part you will decide on a habitat score for this shallow water area.
0 to 20	_____	• Decide on a score between 0 and 20 –Score 20 points if wetland plants cover all of this area –Score 0 points is there are no wetland plants
		Upland or dry land around wetlands provides important habitat for animals that may visit your wetland. Measure 30' out from the wetland and put in a stake. In this part you will survey all the area within 30 feet of the wetland.
0 to 20	_____	• Decide on a score between 0 and 20 –Score 20 points if natural vegetation (trees, shrubs, tall grass and wildflowers) cover all this area –Score 0 points if there is no natural vegetation in this space (mowed lawn is not natural vegetation)
0 to 2 each		**Plant Food**
_____	_____ _____	Plants provide shelter, space and food, including seeds, nuts, berries and nectar for wildlife.
_____	_____ _____	
_____	_____ _____	
_____	_____ _____	
_____	_____ _____	–Score 2 points (up to 30) for each different type of seed, nut, berry or nectar flower found.
	_____	**Total points**

Summary of your survey

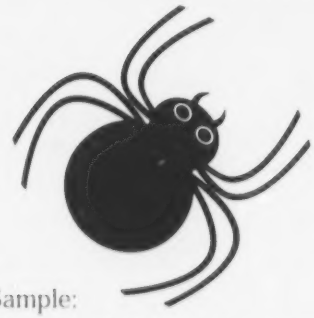
1. How many points would a wetland with excellent habitat score? List three habitat features that would make a wetland habitat score high.

2. How many points did your wetland score?

3. What could you do to improve the habitat score of the wetland?



Wildlife Survey



Go to the area where you will do your habitat project. Your task is to count the number of different wildlife species that use the area. Counting wildlife can be difficult since many wildlife species are secretive and hide when people are around. Others only come out at night. It is sometimes easier to find evidence of wildlife such as feathers, scat (droppings) or burrows. Do not be discouraged if you don't find many types of wildlife. If you know the names of different species list them. For each one seen or heard, make a mark, then add the marks.

Sample:

		Total
Number of different birds seen or heard: (list names if you know them)	| | |	3

1.
Number of different insects and spiders seen
(list names if you know them)

2.
Number of different birds seen or heard
(list names if you know them)

3.
Number of different reptiles or amphibians seen or heard
(list names if you know them)

4.
Number of mammals seen
(list names if you know them)

5.
Number of different types of wildlife you see evidence of, including tracks, fur, feathers, scat (droppings), nests and chewed food.
(list names if you know them)

Step 4
Determine growing conditions

In this step your task is to decide on the growing conditions in your planting zone. Sunlight and water tolerance are the two growing conditions you will investigate. Read the information about sunlight and water tolerance.

Sunlight and Wetland Plants

Plants vary in the amount of sunlight they prefer. Some plants require full sun to produce a flower. In less sunlight, these plants may still grow, although they may produce fewer flowers or no flowers at all. Other plants cannot tolerate full sun and may only grow in shade. Place an X in the box that best describes the sunlight in your zone.

- ☐ *Full sun* means the site is in direct sunlight for at least six hours a day.
- ☐ *Partial sun* means the site receives three to six hours of sunlight.
- ☐ *Shade* means the site receives less than three hours of direct sunlight.

Water Tolerance and Wetland Plants

Wetland plants are called hydro-phytic vegetation. This means water-loving plants. Wetland plants are specially adapted to wet soil conditions. When soil stays wet for a long time, the oxygen is forced out of the tiny spaces between soil particles. This presents a problem for plants since all plant roots need oxygen. Wetland plants have different ways to supply their roots with oxygen. Some wetland plants have hollow stems that allow oxygen to get to the roots. Some plants have special cells in their roots that store oxygen.

Wetland plants vary in the amount of water they can grow in. Some plants can grow in as much as 4' of water. Some plants can grow in 1' of water, while others can only grow in 1" of water. Many wetland plants grow better if the soil surface dries out for part of the year.

Step 5
Determine the number of plants

In this step, your task is to figure out how many plants you need. Use Equation 1 to find the area in square feet. Use Equation 2 to find the number of plants you need.

1. Finding the area: **Area= Length (L) x Width (W)**

Length (L) = _____ **in feet**

Width(W) = _____ **in feet**

Length _____ **x Width** _____ **=** _____ **Area in square feet**

2. Finding the number of plants:

N = $A \div D^2$

N = **number of plants**

A = **area in square feet**

D^2 = **spacing between plants squared. For reforestation projects, use D = 10 ft.**

See chart below to get correct spacing.

A _____ $\div D^2$ _____ **= N** _____

Place an X in the box that best describes the water in your planting zone.

Zone		Water Depth	Plant type	Plant spacing
☐	Zone 5: Flooded	>12"	Submerged aquatic vegetation	2'
☐	Zone 4: Deep wetland	6" to 12"	Herbaceous emergent plants	2'
☐	Zone 3: Shallow wetland	0" to 6"	Herbaceous emergent plants	2'
☐	Zone 2: Wetland edge	Wet and soggy	Herbaceous emergent plants & shrubs	*2'
☐	Zone 1: Upland	No water	Shrubs & small trees	7'

*Select one shrub for every 20 to 25 herbaceous plants.

Step 6
Select plants

Choose several different species of native plants for your zone. Refer to the chart and diagram on the previous page that indicates the type of plants for each zone. Use nursery catalogs and other references to choose plants. Write your selections on the plant chart. Be sure to fill in the plant name, water tolerance, light, cost and number. In the notes column, explain why you selected the plant.

C A U T I O N

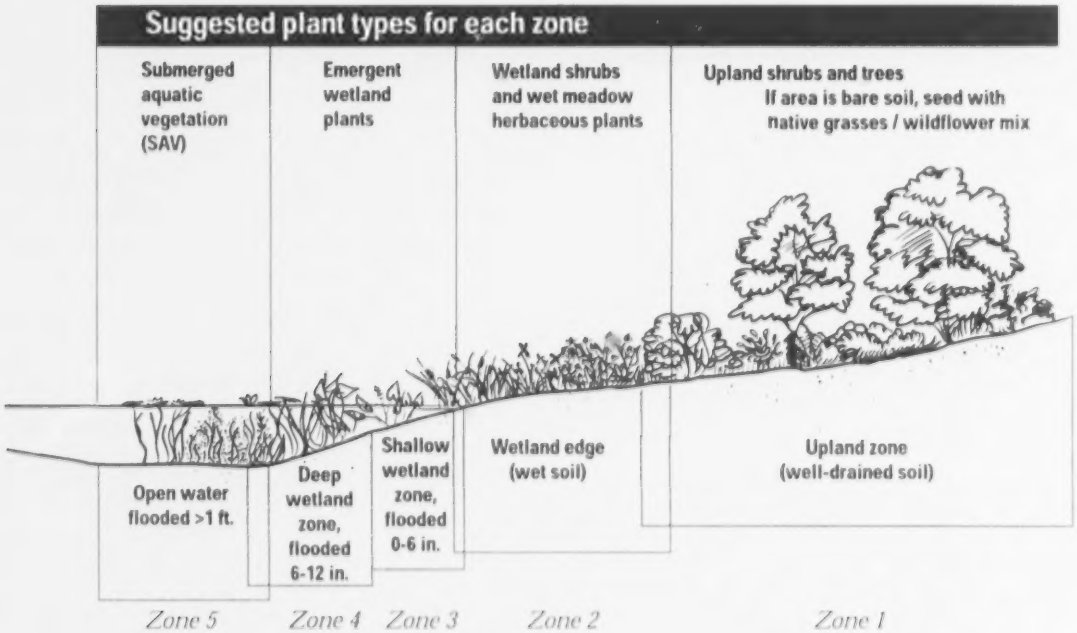
Some plants are invasive. This means they grow rapidly, and can take over a natural wetland. Do not plant the following invasive species.

Phragmites
Purple loosestrife
Cattail
Some willow species
Red maple (in some areas)

Keep the following in mind when selecting plants:

- Use only native plants.
- Select between four to seven species for your zone.
- Choose plants for a variety of wildlife benefits.
- Select plants for the sunlight and water tolerance in your zone.
- Notice that some wetland plants spread rapidly; therefore you do not need to order as many.
- Refer to nursery catalogs while selecting plants so that you choose plants that are available.
- Consider unique features of the plants that interest you.

Suggested plant types for each zone


Submerged aquatic vegetation (SAV)
Emergent wetland plants
Wetland shrubs and wet meadow herbaceous plants
Upland shrubs and trees
If area is bare soil, seed with native grasses / wildflower mix
Open water flooded >1 ft.
Deep wetland zone, flooded 6-12 in.
Shallow wetland zone, flooded 0-6 in.
Wetland edge (wet soil)
Upland zone (well-drained soil)
Zone 5
Zone 4
Zone 3
Zone 2
Zone 1

Plant Chart

Team name_____

Zone_____ Date_____

School name _____

Plant Species - Common name	*Plant Species - Scientific name*	*water tolerance*	*sun*	*# of plants*	*cost of each*	*total cost*	*notes*

Planting Map

Name_____

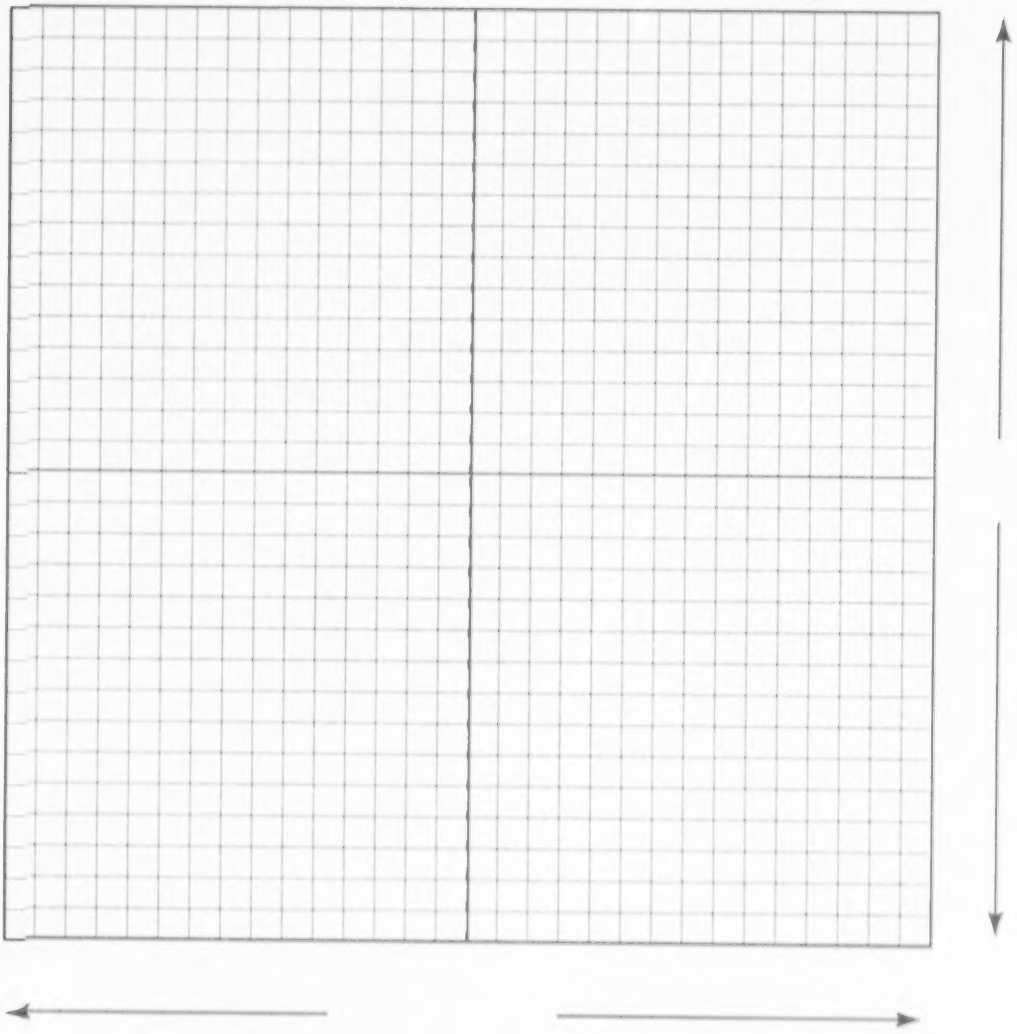
Team Number_____

Team Name_____

Zone_____

Key

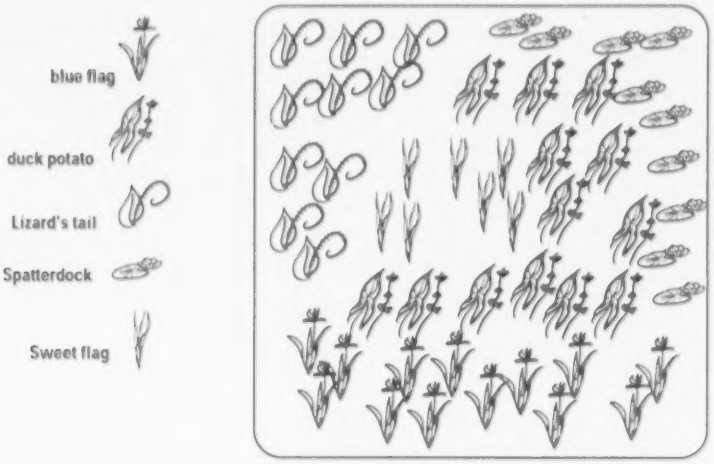
1 =
2 =
3 =
4 =
5 =
6 =
7 =
8 =
9 =
10 =



Step 7
Make a planting map

Your task in this step is to make a map that shows where each of your plants will be planted. Make a key for each species and show where each will be planted. Look at the diagram below to help you. Another type of planting map is on page 45. Notice how similar species are loosely grouped together.

Natural Plant Arrangement



Step 8
Have plan reviewed

Your task in this step is to write a letter to a wetland expert asking them to review your work. All habitat specialists have their work review by their peers. Use the guidelines below to help write your letter.

Writing a Letter

Your group has developed a plan for planting wetland plants for your zone. The plant choices you made were based on water tolerance, sunlight needs, wildlife value and other reasons. You have also made a map of your zone showing where the plants will be planted. It is very important to get advice from an expert before you order the plants. Write a group letter to the wetland specialist.

Before you begin to write, think about the plants you selected, the reasons you selected them and any questions you may have about the plants. Remember to thank the wetland expert for their review of your plan.

Writing prompt: Topic

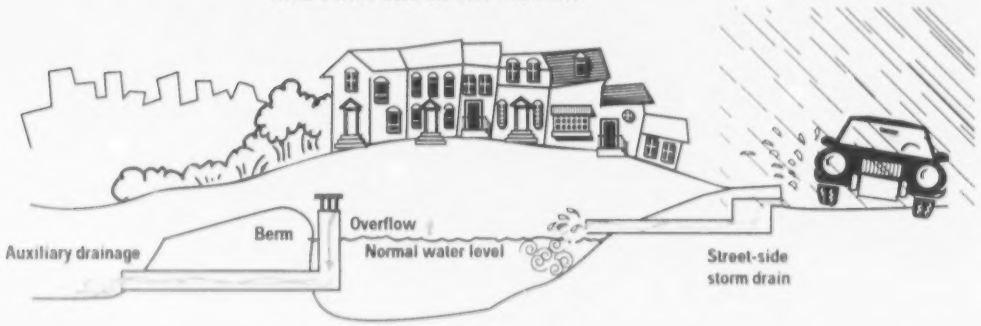
Audience

Purpose

Form

What Are Stormwater Management Ponds?

The human population keeps growing and growing. As the population grows, land that had been meadows, forests and wetlands is developed into houses, schools, roads, shopping centers and other buildings. This creates a problem. When it rains on land that has vegetation (plants) growing on it, the vegetation helps slow down and absorb the rainwater. The water can soak into the soil. This is a good thing since the soil filters and cleans the water before it slowly seeps into a nearby stream. When rainwater falls on land covered with concrete or buildings, the rain cannot soak into the ground. Instead, the water runs across the paved surface and usually into a stormdrain (these are the grates next to the curb). Since there is nothing to slow the water, it rushes down the stormdrain into a nearby stream. Once in the stream, the rushing water carves away soil from the stream bank and makes the water muddy. Muddy water causes harm to aquatic life. As rainwater flows across roads and parking lots, it can pick up many harmful pollutants. The combination of muddy water and pollutants from streets and parking lots harms fish and other life in the stream.



Structures called stormwater management ponds are often built to help reduce the problems caused by stormwater. These ponds catch the water before it enters a stream. The water is then slowly released into a stream. Slower moving water will not erode the banks of streams like fast moving water. Also, some stormwater management ponds hold the water for many days or even all year. In these types of ponds, wetland plants, bacteria and other natural processes help break down pollutants into less harmful substances. Wetland plants also cause sediment to settle out of the water column. While most stormwater management ponds reduce the effects of erosion and pollution, they are not usually designed to provide a natural habitat that is beneficial to wildlife.

Bogs

Bogs are isolated wetlands with no obvious streams or channels flowing into them. They are likely to be covered with sphagnum moss and are very soggy because of high levels of water in the ground. They are usually found in basins that were carved out of the ground by glaciers in the last Ice Age. Bogs get most of their water and nutrients from rain and groundwater. They have very low levels of nutrients. Plants need nutrients to grow. Bog plants have adapted to scarce nutrients. Some plants do not require high levels of nutrients. Other plants trap and consume insects for nutrients. Still others have special bacteria that changes nitrogen gas into a mineral form the plants can use. Bogs function to control flooding, protect against storm damage and provide a stable wildlife habitat.

Typical plants found in mid-Atlantic bogs include Atlantic white cedar, red maple, black spruce, leatherleaf, sheep laurel, American cranberry, sphagnum moss, pitcher plant, sundew, rose pogonia and cottongrass.

Some animals that use bogs as habitat include whitetail deer, black bear, rabbits, mice, voles, shrews, ruffed grouse, black-capped chickadees, parula warblers, barred owls, northern water snakes, eastern ribbon snakes, green frogs, bull frogs, spring peepers, moths, butterflies and bees.

Freshwater Marsh

Freshwater marshes are formed in depressions that hold water long enough to support water-loving plants. Depressions are lined with soft organic muck or clay that helps to hold water. This is an open system where streams bring in water and let it out. Water also comes from runoff, precipitation and groundwater. Water depth varies from several inches to several feet. Shallow freshwater marshes have mainly emergent plants, those with their roots and lower stems in water and upper parts out of water, like cattails, sedges and rushes. Deeper marshes tend to have some water all year and support floating plants, like water lilies, while emergent plants are found along the outer edges of the wetland. The organic muck on the bottom of marshes provides nutrients for plants and energy for the microscopic animals in the food chain.

In addition to being excellent habitats, freshwater marshes also supply water, filter pollutants out of water, catch and temporarily hold water to reduce flooding and provide habitat for wildlife.

Typical plants found in freshwater marshes include buttonbush, leatherleaf, common cattail, narrow-leaved cattail, arrowhead, pickerel weed, arrow arum, tussock sedge, soft stem bulrush, spike rush, three square sedge, wild rice, marsh hibiscus, skunk cabbage and sweet flag.

Animals that commonly use freshwater wetlands include deer, muskrat, bitterns, herons, songbirds, mallards, wood ducks, red-winged black birds, freshwater clams and mussels.

Salt Marsh

Salt marshes are open wetlands where water moves in and out with the tide. They fill in with sediment brought in with the tides. They form in lagoons, bays and behind barrier islands where the water is shallow and land is flat, allowing sediment to build up. Salt marshes have very muddy bottoms formed from decaying plants. The plants that grow here tolerate high levels of salt that concentrate through evaporation of surface water.

Salt marshes have distinct zones based on the depth of water. Closest to the water is salt marsh cordgrass that can stand the twice daily flooding. Behind this, in a slightly a higher and drier area, grows salt meadow hay, which is less tolerant of flooding. At the highest and driest edge of the salt marsh, other plants like seaside goldenrod and marsh elder grow. These wetlands are very productive systems with three main food producers; marsh grasses, algae in the mud and phytoplankton in the water. Salt marshes sometimes give off an odor similar to the smell of rotten eggs. This is from gases given off by bacteria in the salt marsh.

Salt marshes are a nursery ground for young fish and shellfish, making them very important to wildlife and people. They also protect shellfish and fish, control flooding and lessen damage to shorelines by storms.

Plants found in salt marshes include salt marsh cordgrass, salt meadow hay, narrow-leaved cattail and marsh elder.

Animals found in salt marshes include whitetail deer, muskrats, minks, shrews, mice, Canada geese, mallards, black ducks, shovelers, clapper rails, black skimmers, American bitterns, great blue herons, cattle egrets, willets, great black-backed and herring gulls, common yellow throats, seaside sparrows, goldfinches, northern water snakes, eastern garter snakes, diamondback terrapins, American toads, spadefoot toads, sheepshead minnows, Atlantic silversides, shellfish, bees, moths and flies.

Wet Meadow

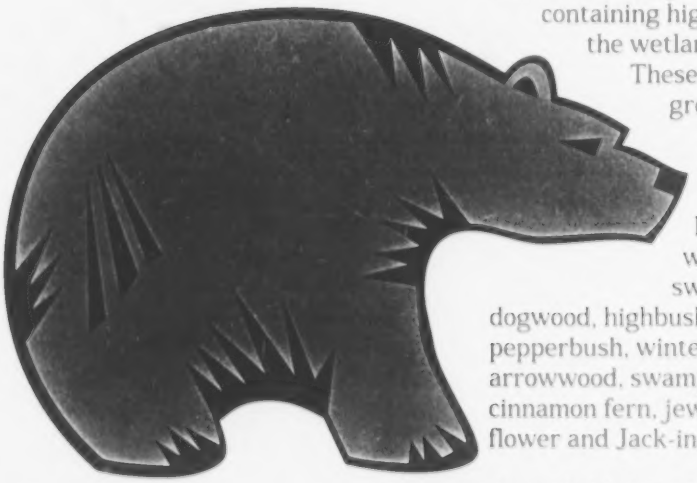
From far away, wet meadows may look like a field. They are full of herbaceous (soft-stemmed) plants and the surface is usually dry in summer. Wet meadows are an open system, getting water from springs, high groundwater and runoff. The water is at or near the surface only during a portion of the growing season. The soils are drier than other types of wetlands and the oxygen levels are higher. Because of the changing conditions throughout the growing season, wet meadows support a variety of wildflowers, grasses, rushes, sedges and shrubs. Left alone, trees and shrubs will eventually grow in wet meadows turning them into forested wetlands. Like other types of wetlands, wet meadows can provide a source of recharge for water supplies, control flooding, filter pollutants and provide habitat for wildlife.

Common plants found in wet meadows include buttonbush, highbush blueberry, sensitive fern, blue flag, Joe-pye weed, boneset, soft rush, tussock sedge and wild rice.

Animals likely to be found here include whitetail deer, rabbits, fox, chipmunks, mice, moles, voles, raccoons, ruffed grouse, wild turkeys, field sparrows, spring peepers, pickerel frogs, leopard frogs, box turtles, wood turtles, moths, bees and butterflies.

Shrub Wetland

As the name implies, the vegetation in shrub wetlands is mostly shrubs in addition to small trees (saplings) and herbaceous (soft-stemmed) plants. Shrub wetlands are considered a transition between wet meadows and tree swamps. They often start in wet meadows, along the edge of streams and rivers or along the edges of shallow marshes. These are open systems with water from runoff and streams or rivers moving in and out. The ground water is usually near the surface to 1 inch deep. Shrub wetlands are generally drier than wet meadow or marshes, due to the buildup of soil created by the decomposition of plants over the years. The small trees and shrubs generally grow on high spots in the swamp, known as hummocks. Their roots cannot tolerate the wetter, lower spots. The soils are rich and fertile, containing high levels of nutrients brought into the wetland by water and decomposition. These wetlands function to recharge groundwater, filter pollutants, reduce flooding and provide excellent wildlife habitat.



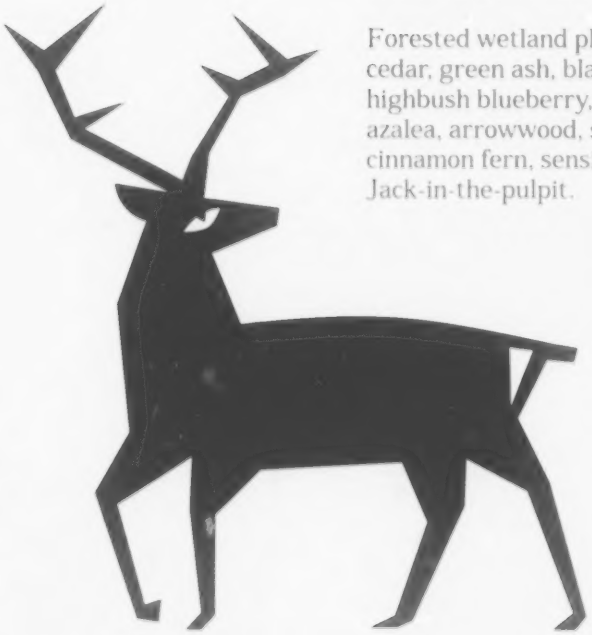
Plants commonly found in shrub wetlands include red maple, swamp azalea, buttonbush, silky dogwood, highbush blueberry, spicebush, sweet pepperbush, winterberry, common elderberry, arrowwood, swamp rose, swamp milkweed, cinnamon fern, jewelweed, sensitive fern, cardinal flower and Jack-in-the-pulpit.

Animals likely to be found here include whitetail deer, mice, black bears, skunks, fox, raccoons, squirrels, chipmunks, ruffed grouse, wood thrushes, veerys, red-eyed vireos, hooded warblers, brown thrashers, box turtles, water and ribbon snakes, garter snakes, bullfrogs, green frogs, leopard frogs, dusky salamanders, moths, bees and butterflies.

Tree Swamp

Tree swamps generally are found in poorly-drained, low areas. They have wet and mucky soils and are subject to flooding in the spring. These are open systems with high ground water that ranges from just below the surface to 1 inch above the surface for a good part of the growing season. Tree swamps are often found neighboring or adjacent to streams, rivers and lakes and are important in supplying water to them. The hummocky or "bumpy" nature of the forest floor creates temporary pools of water in the spring (vernal pools) that are breeding grounds for many reptiles and amphibians. Although trees are the dominant vegetation, shrubs and smaller herbaceous (soft-stemmed plants) do exist where sunlight can reach them. Tree swamps are extremely important for recharging groundwater, filtering pollutants, controlling flooding and providing wildlife habitat.

Forested wetland plants include red maple, Atlantic white cedar, green ash, black gum, hemlock, ironwood, pin oak, highbush blueberry, sweet pepperbush, spicebush, swamp azalea, arrowwood, shad bush, poison ivy, jewelweed, cinnamon fern, sensitive fern, skunk cabbage and Jack-in-the-pulpit.



Animals inhabiting forested wetlands include whitetail deer, raccoons, rabbits, fox, squirrels, beavers, river otters, mice, shrews, warblers, herons, wood ducks, mallards, barred owls, painted turtles, brown water snakes, bullfrogs, green frogs, spring peepers, American toads, spotted salamanders, sunfish, killifish, chain pickerel, crayfish, butterflies and moths.

Chapter 4

Meadow Habitat Project

Teacher Section

Step 1 Background research

Step 2 Growing conditions

Step 3 Measure size of plot

Step 4 Develop a seed mix

Step 5 Ground preparation

Step 6 Planting day

Step 7 Management and maintenance

Introduction

Overview

This sections covers the basic steps needed to plant a meadow (eastern U.S.) or prairie (central U.S.). These are grassland habitats with a mix of grasses and wildflowers. The size of the project does not matter; however, the larger the meadow the more diversity of wildlife you will see. Meadows provide critical habitat for many species of wildlife including ground-nesting birds, butterflies, other insects and small mammals.

Much of the work involved with creating a meadow involves the logistics of how and when to prepare the ground. The group leader will be responsible for the logistics and can decide how much involvement students will have. Students will be involved with gathering data about the site, possibly picking species and planting the seeds. Ground preparation can begin six months in advance of the anticipated planting day.

How to begin

This project does not follow an orderly progression of steps. Therefore, it is best to read through the steps and map out a plan that will work best for you. The timing of the project depends on when and how the ground is prepared.

Estimated time for students to complete the project

Students will need about four to six hours to complete the planning process, more if you have them choose individual species. Depending on the size, it can take one hour or one day to plant.

Resource team role

The logistics involved with preparing the ground should be done by the resource team.

Sources of expertise

1. State natural resource agencies
2. Seed company ecologists (most can provide helpful hints over the phone)
3. University botany or horticulture departments
4. Local botanists
5. Naturalists and native plant societies

General considerations for planning the project

A good size for a small school meadow is 1,000 square feet. A good medium size school meadow is 1/4 to 1/2 acre. A larger meadow of an acre or more can be planted in sections over time. Larger meadows provide many more environmental benefits.

For large sites, seeding is the easiest and most economical method. Seeding produces a more natural, random scattering of plants. For small sites, plants can be used. If plants are used, space them on 2' centers. If the meadow is seeded, the seeded area can be supplemented by adding meadow plants throughout the seeded area. The plants will provide a more immediate result. Another reason to use plants is that certain species are difficult to plant from seed.

Step 1 Background research

Have students read the page titled *Meadows for Wildlife*, page 96.

Order seed catalogs

While requesting a catalog, ask if the company sells or can create a mix of species that are native to your area. This should not be confused with a seed mix that will grow in your area (for example, California poppies will grow in Virginia). Your state natural heritage program may be able to recommend a good seed source. Call or order catalogs or have students call or write letters requesting catalogs.

Materials
copies of page 96

Step 2
Growing conditions

Students will determine the amount of sunlight, the soil moisture and the soil texture. Students will use this information to select a seed mix that is best adapted to the site.

- *Sunlight.* Students will decide if they have full sun, partial sun or shade (descriptions given on page 97). If it is not obvious, students may need to develop a method to measure the light throughout the school day. A simple method is to draw the boundaries of the planting area on graph paper and have students go out each hour and mark on graph paper the line between sun and shade. This should help them make an informed decision.

- *Soil Moisture.* Students will decide if the soil moisture is wet, dry or mesic (medium). When deciding how moist the site is, have students go out two to four days after a rainstorm. If the site is dry (well drained), most of the moisture will be gone. If the site is wet (poorly drained), the site should still be wet and soggy.

- *Soil Texture.* Have the students use the soil texture chart on page 99 to determine the texture. Many plants will grow in a range of soil textures. Some plants prefer a specific texture.

Materials
shovel
water bottle
copies of pages 97-99

Step 3
Measure the size of the meadow

Students should figure out the size of the meadow in square feet. It is important to get an accurate measurement so that the correct amount of seed can be ordered.

Materials
tape measure or a trundle wheel
copies of page 98

Step 4
Develop a seed mix

In this step students will use the three sample seed mixes on page 101 to help them develop their own seed mix. The sample mixes contain common native plants found in the mid-Atlantic region. If you are outside this region, contact your local department of natural resources for a list of local native meadow plants. For this step you will need seed catalogs and a wildflower guide. Students will use these resources to look up each plant and decide if they want to include it in their mix. If they do, then they should list it on the Meadow Planning Chart, page 102. Make sure they fill out each column of the chart. In the bloom period column, they should darken in or draw a line across the months that the species bloom. Students should also use the seed catalogs and wildflower books to include other species not found in the sample mixes.

Students should use the following criteria when selecting species:

- Select species that are native to your area. This can be confusing. For example, many seed catalogs have mixes for different regions of the country. This does not necessarily mean that the species are native to that region. It only means that they will grow there. Sometimes the catalogs specify native. For example, a mix may be called Native Northeast Mix—this should include species native to the Northeast.

- Develop a mix that has eight to 15 species of wildflowers and two to three species of native grasses. The grasses grow in clumps and provide important cover for ground-nesting birds. Grasses also provide visual interest in the winter with their golden, bronze and copper-colored stalks.

- For optimum wildlife benefits and visual interest, select a variety of species that will bloom during the entire growing season. Most nursery catalogs provide information on bloom period and color. Make sure some species will bloom when students are in school.

Materials
wildflower guides
seed catalogues
copies of pages 100-102

Step 5
Prepare the ground, and plant the meadow

Hand broadcasting seed and using a no-till seed drill are the two seeding methods outlined. Several ground preparation options are provided for each seeding method depending on the size of the project and method chosen. Select the ground preparation option that best fits your needs and be diligent about completing the recommended steps. Success is achieved with thorough ground preparation.

On most school sites, ground preparation means thoroughly removing grass before seeding. Some of the ground preparation options include the use of a herbicide. While using a herbicide on a schoolyard can be controversial, it is included since it is the most accepted and proven method used by professional grassland ecologists for prairie or meadow establishment. It is the most reliable method to remove unwanted weeds and persistent turf grass and, if done thoroughly, will not need to be used again. The rationale behind using a herbicide is that the long-term environmental benefits of a well established grassland far outweigh short term environmental impacts that may be caused by herbicide use.

The recommended herbicide is a glyphosate. Soil microorganisms break down the active ingredient in glyphosate herbicides within one week. The herbicide should be sprayed when the target plant (usually lawn grass) is green and actively growing and the soil temperature is above 55 degrees (usually mid to late April in central Maryland). Herbicides will not work on brown, dormant grass.

When applying herbicides on school grounds, use extra caution. A licensed applicator should apply the herbicide. It is likely that the school system has a licensed applicator. Students should not be on the area during spraying and should be kept out of the sprayed area for at least a week. An ideal time to spray is over a weekend or when students are on an extended break.

Method 1 Hand broadcast seeding method

Hand broadcasting seed is feasible on sites up to an acre. Depending on the size of the meadow, equipment needed for ground preparation varies from shovels and rakes to a disc pulled behind a tractor. More ground preparation steps are involved with this method compared to using a no-till seed drill. An option for larger areas is to divide the site into smaller sections and hand broadcast one section each year. The benefit to this approach is that many students can be involved over time. Students can collect seeds from established sections to plant the next section.

Ground preparation for small sites with existing turf

Option A

Feb-April: Remove sod by scraping with a shovel or use a sod cutting machine. Be sure to remove all the roots of the grass. A sod cutting machine can be rented from a tool rental store. Next, lightly till or rake the soil. Water the site to stimulate the germination of dormant weed seeds. Wait for two weeks of warm weather to allow dormant weeds to germinate.

May Remove all weeds by hand (or with glyphosate herbicide). Plant the seed following the steps below for hand broadcasting.

Option B

Feb-April Remove the sod and cover the site with black plastic. Cover with mulch to hold the plastic in place. This process should kill any remaining weeds or grass.

September-October Remove the plastic. Plant the seed following the steps below for hand broadcasting.

Ground preparation for large sites with existing turf

Option A

Feb-April Spray the turf with a glyphosate herbicide.

May After the grass turns brown, lightly till or disk the ground. Remove clumps of grass. Wait two weeks and apply herbicide again if weeds and grass re-sprout.

May-June Plant the seed following the steps below for hand broadcasting.

Option B

April-September Roto-till or disc the site several times waiting two to three weeks between each tilling. Each time more grass and weeds will be removed.

Late July If the seed bed appears to be weed-free two weeks after the last tilling, plant the seed following the steps on page 92 for hand broadcasting. When planting in July, save 1/2 of the wildflower seeds and plant in the fall (a precaution against a summer drought). If weeds persist, continue tilling every few weeks and plant in October. Thorough removal of weed and grass is less predictable using this method.

Steps for hand broadcasting

1. To ensure even distribution of seed, mix seed with three to five parts moist sand, sawdust or peat moss medium. Moisten the medium just enough to allow the seed to stick.
2. To ensure good coverage, spread half the mix evenly in one direction. Spread the other half walking perpendicular to the first pass.
3. Lightly rake or drag a piece of chain link fence across the soil to ensure good soil to seed contact.
4. Compress the soil to ensure soil to seed contact by rolling, having children stomp throughout the entire site or drive over the site with a pickup truck.
5. Seed germination is increased if straw mulch is lightly spread across the site. The straw keeps the soil moist allowing for better seed germination.
6. Watering will enhance germination when planting in spring or early summer.

Method 2 No-till seeding method

Establishing a meadow using a no-till drill is a simple and effective method. The main benefit of no-till is that dormant weed seeds are not brought to the soil surface through tilling. It is the most practical method for hillsides where soil disturbance promotes erosion. The no-till method is generally used on large sites, since the drill is pulled behind a tractor. Special no-till drills must be used due to the fluffy nature of the native grass seeds. No-till drills (referred to as Truax or warm-season grass drill) may be available for loan through state natural resource departments, Soil Conservation Service offices and certain National Wildlife Refuges. Some landscape contractors have the special drill and can be hired to prepare the ground and plant the meadow. If you plan to do it yourself with assistance from a farmer, an experienced person from a natural resource agency or contractor should be on hand to supervise the seeding. If a local farmer agrees to help, make sure the hydraulic connection is compatible between the tractor and drill.

If a no-till drill is used, use all the grass seed and half of the wildflower seeds (when ordering, specify that you want the grasses and wildflower seeds in different bags). Save the other half of the wildflower seeds to be hand broadcast by students the following fall. This allows students to be involved in the planting. Wildflower germination is also generally better when seeded in the fall. To complete this step, in October, students should roughen patches of soil in the seeded area with a rake then follow the steps for hand broadcasting.

Ground Preparation

Option A

April-June Spray the turf with a glyphosate herbicide. Wait until the grass turns brown. If grass kill has been complete, plant the seed with the no-till drill. If portions of grass are not completely killed, spot spray these areas. If a follow-up herbicide application is needed, the seed can be drilled the same day the herbicide is applied.

Option B

April-September Roto-till or disc the site several times. Each time more grass and weeds will be removed.

Late June If you are satisfied that the seed bed is mostly weed free, roll the site to create a firm seed bed then plant with the no-till drill. When planting in July, save 1/2 of the wildflower seeds and plant in the fall (a precaution against a drought summer). If weeds persist, continue tilling every few weeks and plant in October. Thorough removal of weed and grass is less predictable using this method.

Step 6
Carry out management and maintenance

A yearly maintenance plan needs to be developed with the grounds supervisor. A mower or bush-hog that can adjust to a height of 6" to 8" is needed to properly mow large sites. A weed whacker or scythe can by used to cut small sites.

The first year requires special attention to reduce weeds. Remove weeds by hand on small sites. For large sites, mow to a height of 6" to 8" every six weeks. Mowing eliminates annual weeds before they go to seed and will not harm new wildflower seedlings and native grasses. If weeds are not evident, mowing is not necessary.

Beyond the first year, annual mowing is needed. Divide the meadow into two or three sections. Mow one section (at a height of 6" to 8") each year on a rotation before April 1st or after August 15th to avoid the nesting season of small mammals and ground nesting birds. Mowing only one section each year allows cover for wildlife to remain at all times. Butterfly and other insect larva will survive in the uncut portion. An optimal mowing schedule that maintains the most wildlife cover is to mow one-third of the site every March.

After mowing, remove cut material and thatch. This practice opens the soil to light, promoting the growth of new meadow plants. Removing thatch can be done with a hand rake on small sites or a mechanical rake pulled behind a tractor on large sites. A controlled burn can also be used to remove

thatch, remove woody species and promote new growth. Burning should be done on a rotation similar to the recommended mowing schedule. In the Midwest, where prairie restoration has been underway since 1970, burning is an accepted and necessary management practice even on school grounds. Strict precautions are necessary if burning is done on school grounds. Contact your local fire department or a specialist from your state natural resource agency to oversee a controlled burn.

Meadows

Student Instructions

The goal of this project is to create a meadow by planting seeds. A meadow has grasses and wildflowers. The main challenge is to figure out which plants will grow the best on your site. The meadow should provide excellent habitat for small mammals, birds, butterflies and other insects.

Meadows for Wildlife

Step 1
Background information

Meadows are grassland habitats that include a mix of wild grasses and wildflowers. They provide important habitat for many species. One plant can provide food or special needs for 10 to 30 species of wildlife.

Animals use meadows for food. All plant parts including leaves, flowers, seeds, pollen or nectar are eaten. A meadow's tall grasses and wildflowers create lots of hiding places where wildlife can find shelter. Meadows provide critical space for ground nesting birds, like quail and meadowlarks, and a variety of small mammals, such as rabbits, shrews and voles. These species attract predators including foxes, hawks and owls. In the summer, meadows are alive with brilliantly-colored butterflies and many other interesting insects. Insects provide important food for many types of birds and small mammals. Insects are also very important for pollinating food crops.

Grasslands are also important to people. Prairies (grasslands in the Central United States) have rich soil that allows farmers to grow much of the world's corn and wheat. Over thousands of years, prairie plants created the rich topsoil. Some prairie plants have long tap roots that can grow more than 10' deep. The deep roots along with tons of decaying leaves from the previous years growth created the rich deep soil. The original prairie grasslands stretched from the Rocky Mountains to the Ohio Valley and once covered more than 400,000 square miles.

Throughout the country, grasslands have been replaced by crops, pastures and development. Consequently, many wildlife species that depend on grasslands are disappearing. Many people are working to create grasslands to help restore plant and animal populations.

Questions

1. What do you expect your meadow to look like?

2. What types of animals do you expect to attract?

Step 2
Growing conditions

In this step your task is to decide on the three growing conditions in the area you will plant the meadow. By knowing the growing conditions, you will be able to pick a seed mix that will grow well on the site. Go to your site and follow the directions for each section.

Sunlight

Place an X in the box that best describes the sunlight on your site. If it is not obvious, figure out a method to measure the light throughout the day. Then place an X in the correct box.

☐ *Full sun* means the site is in direct sunlight for at least six hours a day.

☐ *Partial sun* means the site receives three to six hours of sunlight.

☐ *Shade* means the site receives less than three hours of direct sun.

Moisture

In this step you will decide if the soil moisture is dry, wet or mesic (average moisture). Dig a hole 8" deep. Take a handful of soil from the bottom of the hole. Read the descriptions of the three choices and check the box that best describes the soil moisture.

☐ *Dry soil (very well drained).* Soil does not feel wet. After rainstorms, puddles do not remain for more than a few hours. In many cases dry soils are sandy. They are common on hillsides, especially those that face south.

☐ *Mesic soil (medium drainage).* This is average soil moisture —not dry and not wet. Soil may feel cool and damp but not soggy. Mesic soil moisture can be found in many different areas.

☐ *Wet soil (poorly drained):* The soil is wet and soggy. After rainstorms, puddles remain for several days or weeks. Many wet soils have a high amount of clay. Wet soils are usually found in low-lying flat areas.

Soil Texture

In this part, decide what the soil texture is. Follow the directions on the soil texture chart on the next page. Place an X in the box that best describes the soil texture.

☐ Sand	☐ Clay loam	☐ Loamy sand	☐ Silty clay loam
☐ Sandy loam	☐ Sandy clay	☐ Loam	☐ Clay
☐ Silt loam	☐ Silty clay	☐ Sandy clay loam	

Summary of growing conditions

Sunlight_____

Moisture_____

Soil texture_____

Step 3 Measure the size of the meadow

In this step, your task is to figure out the size of your meadow in square feet.

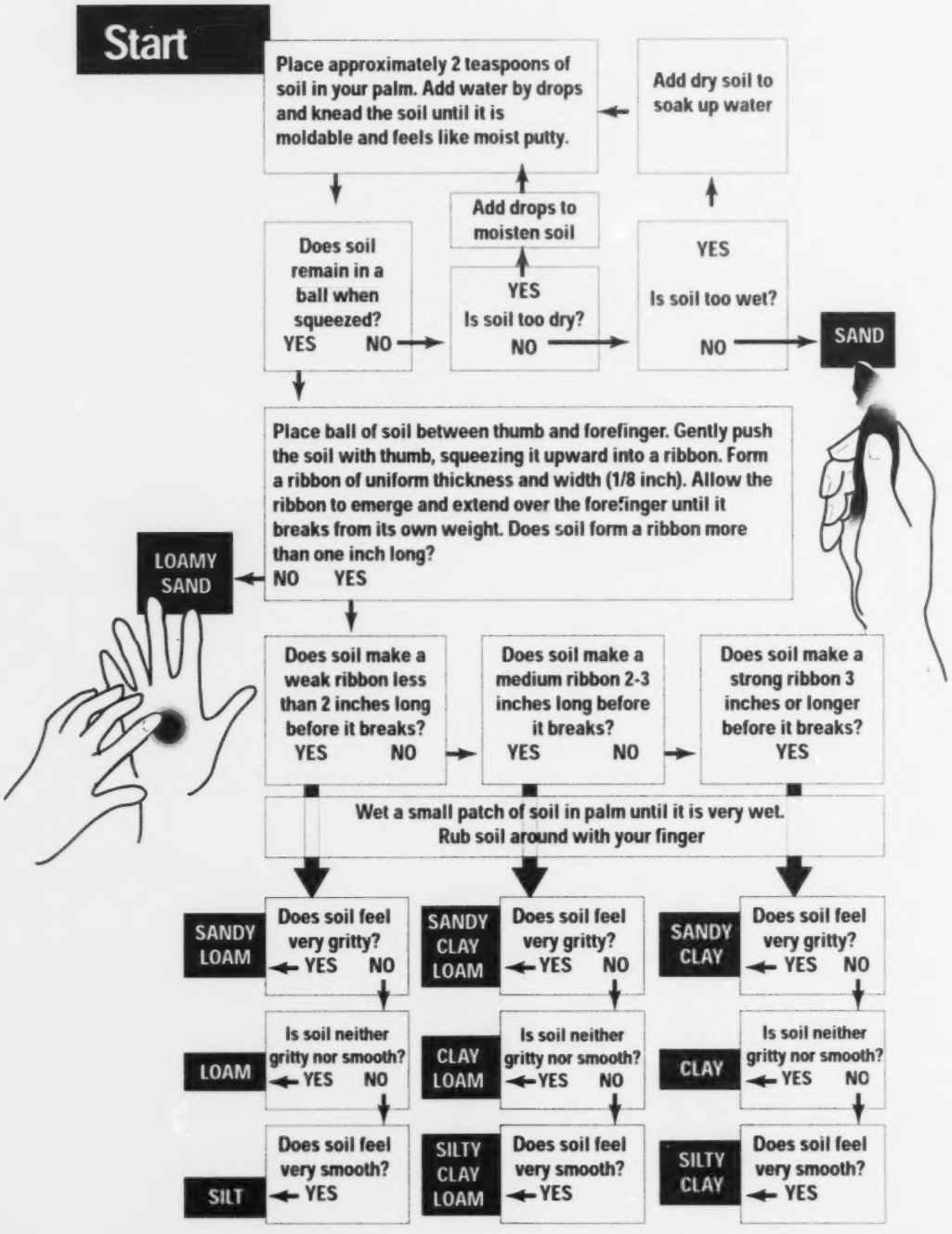
Area= Length (L) x Width (W)

Length (L) = ☐ in feet

Width(W) = ☐ in feet

Length ☐ x Width ☐ = Area ☐ in square feet

Soil Texture Chart


Start
Place approximately 2 teaspoons of soil in your palm. Add water by drops and knead the soil until it is moldable and feels like moist putty.
Add dry soil to soak up water
Add drops to moisten soil
Does soil remain in a ball when squeezed? YES NO
YES Is soil too dry? NO
YES Is soil too wet? NO
SAND
Place ball of soil between thumb and forefinger. Gently push the soil with thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width (1/8 inch). Allow the ribbon to emerge and extend over the forefinger until it breaks from its own weight. Does soil form a ribbon more than one inch long? NO YES
LOAMY SAND
Does soil make a weak ribbon less than 2 inches long before it breaks? YES NO
Does soil make a medium ribbon 2-3 inches long before it breaks? YES NO
Does soil make a strong ribbon 3 inches or longer before it breaks? YES
Wet a small patch of soil in palm until it is very wet. Rub soil around with your finger
SANDY LOAM
Does soil feel very gritty? YES NO
SANDY CLAY LOAM
Does soil feel very gritty? YES NO
SANDY CLAY
Does soil feel very gritty? YES NO
LOAM
Is soil neither gritty nor smooth? YES NO
CLAY LOAM
Is soil neither gritty nor smooth? YES NO
CLAY
Is soil neither gritty nor smooth? YES NO
SILT
Does soil feel very smooth? YES
SILTY CLAY LOAM
Does soil feel very smooth? YES
SILTY CLAY
Does soil feel very smooth? YES

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Step 4
Develop a seed mix

Next you will decide on the types of wildflowers and grasses to plant in the meadow. You will develop your own seed mixture. To do this, use the sample seed mixes as a guideline. The sample mixes contain common meadow plants found in the mid-Atlantic region.

Steps to complete

1. Decide which of the mixes would best fit your site conditions.
2. Use seed catalogs and wildflower field guides to look up and learn about the plants. If you want to include the plant in your mix, write the name on the Meadow Planning Chart, page 102. Fill in all the columns on the chart.
3. Look through the seed catalogs to see if there are other plants you want to include in the seed mix. Write the names of these on the chart. Use the following criteria when selecting additional plants.

- Select species that are native to your area.
- Select eight to 15 species of wildflowers and two to three species of native grasses.
- Select species that are adapted to the growing conditions of the site.
- Select a variety of species so that something is in bloom every month.
- Consider the different colors of the flowers.

Step 5
Prepare the ground and plant the meadow

A very important part of your meadow project is preparing the ground for planting. There are several different methods that can be used. Your teacher will explain the method chosen for your site.

All of the planning and ground preparation is complete. You are now ready to plant your seeds. The steps involved are:

1. Mix the seeds with moist sand so they are easy to spread.
2. Lightly rake the planting area.
3. Spread the seed across the ground. Be sure to cover the entire area.
4. Stomp up and down across the entire planting area to push the seeds into the soil.

Meadow Mixes for the Mid-Atlantic Region

The following three mixes contain species that are somewhat common and available from seed suppliers. We encourage you to modify and add to the mixes.

Dry Soil

(mostly sandy to loamy)

Flowers
Butterfly Milkweed (Asclepias tuberosa)
Common Milkweed (Asclepias syriaca)
Heath Aster (Aster ericoides)
Partridge Pea (Cassia fasciculata)
Showy Tick Trefoil (Desmodium canadense)
Wild Lupine (Lupinus perennis)
Wild Bergamot (Monarda fistulosa)
Black-Eyed-Susan (Rudbeckia hirta)
Gray Goldenrod (Solidago nemoralis)

Grasses
Little Bluestem (Andropogon scoparius)
Indian Grass (Sorghastrum nutans)
Canada Wild Rye (Elymus canadensis)

Medium Soil

(loam to silty clay loam)

Flowers
Common Milkweed (Asclepias syriaca)
New England Aster (Aster novae-angliae)
Zig-Zag Aster (Aster prenanthoides)
Flat-Toped White Aster (Aster umbellatus)
Showy Tick Trefoil (Desmodium canadense)
Wild Blue Lupine (Lupinus perennis)
Wild Bergamot (Monarda fistulosa)
Black-Eyed-Susan (Rudbeckia hirta)
Stiff Goldenrod (Solidago rigida)
Hoary Vervain (Verbena stricta)

Grasses
Little Bluestem (Andropogon scoparius)
Canada Wild Rye (Elymus canadensis)
Indian Grass (Sorghastrum nutans)

Wet Soil

(typically high clay content)

Flowers
Swamp Milkweed (Asclepias incarnata)
New York Aster (Aster novi-belgii)
Nodding Bur Marigold (Bidens cernua)
Joe-Pye Weed (Eupatorium dubium)
Spotted Joe-pye Weed (Eupatorium maculatum)
Boneset (Eupatorium perfoliatum)
Rough-Leaved Goldenrod (Solidago patula)
Blue Vervain (Verbena hastata)
Ironweed (Vernonia noveboracensis)

Grasses
Big Bluestem (Andropogan gerardi)
Fox Sedge (Carex vulpinoidea)
Soft Rush (Juncus effusus)
Sensitive Fern (Onoclea sensibilis)
Switch Grass (Panicum virgatum)

Name _____ Team _____ Date _____

Conditions
Sunlight _____
Soil texture _____
Soil moisture _____

Meadow Planning Chart

Plant species (Common name)	Plant species (Scientific name)	Native plant? Yes or No	Flower color	April	May	June	July	August	Sept.	Oct.	Notes

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Relative Sizes of Very Fine Sand, Silt and Clay

Due to the small particle sizes, air spaces between clay and silt particles are small; therefore, water drains slowly through silty and clayey soils.

Air spaces between sand particles are larger; therefore, sandy soils drain well.

Writing a News Release

A news release is a way to inform television and radio stations and newspapers about an issue or an event. It presents facts clearly, briefly and completely. A news release should contain enough information so that it can be used without the newsperson calling back for more facts.

Before writing the news release, decide the purpose of the release and the most interesting aspects of the story. Make sure you have verified all spellings, figures, full names and titles.

The first paragraph should contain the "five W's." These are answers to the basic questions - who, what, where, when and why (and sometimes how). Additional paragraphs can provide more detailed information. When writing a news release, keep the following in mind:

1. The news release should capture the attention of a reporter or editor;
2. Tell the most important part of the story in the lead (first paragraph);
3. After the lead, elaborate on details;
4. Keep news releases short (40 or fewer sentences);
5. Follow the basic style below.

Stationery: For the first page, use letterhead stationary (if available). If not, use white bond typing paper with the name and address of the person or organization issuing the release and the words "News Release" or "Media Alert" in the upper left corner.

Release time: Flush left and underlined, type "For release on" and add the date you want the news media to publish the release or type "For immediate release" if you want it published as soon as the news media receive it.

Contact: Flush right, type name and phone number of a person the press can contact for more information. Make sure the contact person will be available and responsive to calls.

Title: Centered, bold-face type; identifies content of the release; use an action verb like "plant."

Sample press release

- Name of organization
- Address of organization
- News Release
- For release on (month, day year) or For immediate release
- Contact: Name of person
- Phone number
- Title
- Lead paragraph answering the five W's
- More detailed information in following paragraphs

Body: Double spaced. First sentence of each paragraph should be indented. Do not break sentences or paragraphs between pages. For releases longer than one page, the word "more" should be centered at bottom of first page. End releases with 3 x's (with spaces between) or the word "END" centered at the bottom.

EVERGREEN Elementary School 33 Cool School Lane, Birdstown Maryland 01401

NEWS RELEASE
For Immediate release

For Information Contact:
Gloria Fuggles (410) 555-0000

Students Going Wild At School

Fifth graders at Evergreen Elementary School in Birdstown, Md., are doing more than reading about wildlife; they are creating homes for wildlife right on the schoolyard. On April 21, from 9 a.m. to noon, students, teachers and local citizens will plant more than 200 wetland plants and shrubs into a barren stormwater pond as a first step in changing it to a thriving freshwater marsh.

Once established, the marsh will provide food, water, cover and nesting area (collectively known as habitat) to a variety of birds, amphibians, small mammals and other wildlife. Besides providing homes for wildlife, the marsh can be used by students and teachers as an outdoor classroom. Students will have the opportunity to learn about wetlands, study wildlife and the environment, and conduct scientific experiments without even leaving the school grounds.

"These kids are really excited about actually creating habitat for wildlife," said Gloria Fuggles, the students' teacher and supporter of the project. "We've even managed to involve the entire community."

Directions: From Annapolis take Route 50 south to Exit 42 west. At first stoplight, turn right onto Cool School Lane. Follow to school. From Baltimore, take Route 87 south to Exit 22 east. At first stoplight, turn left onto Cherry Road. At next stoplight, turn right onto Cool School Lane. Follow to school.

XXX

Creating a Schoolyard Tree Nursery

by Cathy Dueck

Revised and reprinted with permission from Green Teacher Magazine

Growing your own trees is a great way to encourage a life-long friendship with a larger family of living things. When students are involved in collecting seeds, and seeing the growth and development of seedlings over a period of time, they begin to understand that trees are dynamic, living things, and not just pieces of wood stuck in the ground.

A range of curricular activities can be tied in with the growth of young trees. Which trees grow the fastest? Why? Do some get more shade than others? How does this affect their growth? Are any animals or insects munching on your trees? What clues do they leave behind? Are the same kinds of trees growing in your neighborhood? Where do they grow (wild, cultivated, wet, dry)? What other kinds of plants and animals can be found nearby?

Frequent exposure to the young seedlings can help students, parents and teachers easily recognize different types of trees and become familiar with what each needs to grow and thrive. As the trees grow bigger, students can participate in choosing suitable permanent planting locations.

A tree nursery is also a wonderful symbol for progressive environmental education. Through respectful observation and positive involvement, we can all learn to play an important role in the processes of renewal and restoration. Growing trees is an adventure where there are no failures, just great opportunities to learn together. And it can all begin in your own schoolyard!

Start Small

A nursery can be a perfect place to learn basic skills before moving out into the larger schoolyard. Seedlings grown in a clearly marked nursery area are much less prone to damage by trampling or lawn mowing than those planted directly in their permanent sites. When they're bigger, they can be transplanted to their new homes, already accustomed to the soil and weather in your schoolyard.

You don't need much space to get started. Most important is a location with some protection from sun and wind, and access to water. Sometimes the school building itself breaks the wind and provides shade. An ideal location will have dappled shade, with a touch of sun for plant growth. Commercial growers often put shade frames over their young plants (a simple frame covered with snow fencing).

Choose a location that is easy to water. A space close to an outdoor faucet is a good choice. If you're able to collect rainwater, that's even better. While young seedlings don't require a lot of care, they need regular watering. If you're lucky, Mother Nature will do the job for you. If not, make the task as simple as possible.

It is surprising how many young trees can be grown in a small space. A growing bed 1 x 3 meters can support roughly 20 to 30 young trees (to 1 meter high) or several hundred tiny trees in their first year or two of life. A space of 3 x 3 meters would give you enough room for two growing beds with walking paths all around.

Preparing a Growing Bed

You will need to prepare your site before planting begins. We prefer raised growing beds when working with children in the nursery. Here, the plants are growing slightly higher than the walking paths. It helps us all to remember where to walk, and reduces soil compaction around the young trees.

Make sure your growing beds are no wider than 1 meter, so that the plants can be tended easily from either side without walking on the bed. Use boards or logs (up to 20 cm high) to surround the bed, and add a light soil mix to fill it. You can dig up the soil that is already there (be sure to shake out and remove sod and weeds) and top it up with soil from the path area if necessary. Mix in about one-third compost or peat and a sprinkling of bone meal to promote healthy root growth. If your soil is heavy clay, some sand will help to loosen it up.

Seeds or Transplants?
Several schools in our area have started by planting young trees from local growers or forest stations. These are not expensive, and are sometimes available free of charge to schools. You simply order the number and species you want, and then transplant the tiny trees to their nursery when they arrive. Here, they get loving attention for one or two years and then are moved to a permanent planting site.

Another approach, which offers an even better learning experience, is to grow your trees from seed you've collected yourselves. This is a great way to learn how and where trees grow, what is found in your area, and what kinds of plants usually grow together. Go for walks in nearby natural areas and see what's growing around you. Taking along a local naturalist or a good field guide can help you get started. We like to focus on plants that are native to our area. Since this will change from place to place, check a basic reference book or call your local forest station to learn which trees are part of your heritage, and how to recognize them.

Spring Seeds
Each kind of tree has an optimum time of year for seed collection. There are several types of trees whose seeds mature in late spring or early summer, and most of these seeds will grow without much pampering. If you look closely, you will notice that many of these early birds produce their flowers before the leaves come out. These flowers tend to be small and unobtrusive, but you will see a flush of color on the tree for a week or two before the leaves unfold. Trees in this category include elm, silver maple, red maple, and poplars. Their seeds will be ripe in late spring, and you can often pick them right off the tree or collect them from the ground. Don't wait too long, though, or most of them will have blown away!

If you scatter the seeds over a prepared seed bed, and keep them fairly moist, many will sprout without any coaxing. Be sure to label all trees and seeds. Waterproof markers on wooden stakes work well. Keep a paper map indoors of what you planted where, and when, in case the stakes are pulled up.

Young seedlings should not be allowed to dry out. You can reduce the workload by covering the soil surface with an organic material such as leaves, straw or wood chips. This will help to conserve water and keep down weed growth. Water only when the surface feels dry to the touch, so you don't waterlog your seedlings. A watering can is a perfect way to deliver a gentle flow of water.

Fall Seeds

Autumn is another important season for seed collection at school. The seeds of many trees ripen in the fall, and can be directly planted in the tree nursery at this time. Sugar maple, Manitoba maple, oaks, black walnut, white ash can all be collected when the seeds are ripe, and planted directly outside in seed beds. You can also look for seeds inside the cones of evergreens such as pines, spruce and cedar, but they will blow away soon after the cones open up. Collect the cones just as they start to open and store them in a paper bag. This way, you can catch the seeds as they fall out.

Nuts, especially, must be protected from foraging squirrels by a wire cover (chicken wire or hardware cloth). If you're using raised growing beds, you can staple the wire directly onto the wooden frames. Many of these later ripening seeds need to be exposed to a cool winter period before they will grow. It's nature's way of ensuring that they wait until growing conditions are ideal. If all goes well, you will find lots of sprouts the following spring.

Long-Term Care

While young seedlings don't require much care, be sure not to forget about them. Arrange for families to share summer maintenance, and plan the occasional weeding bee. It's not good to let the weeds get taller than the trees! Spending a little time regularly ensures that the work load is pleasant and manageable.

If you find that your seeds sprout and grow up too close together, you can space them out when the weather is cool. Just dig them up and replant a little farther apart and water well. You may have to repeat this thinning process as the trees get bigger in the next year or two. The best time for transplanting is spring or fall when the trees are dormant.

By the time your trees are about 1 meter high, you'll probably want to move them to a permanent planting site (or a bigger nursery area!). Dig them up carefully in early spring or late fall, trim up the roots a bit, and transplant them in the same way as for trees from commercial nurseries. Remember to replant the tree at the same depth it was growing in the nursery. A color change on the bark of the trunk will show you where ground level should be.

Pointers for Success

Make sure that the students are involved in the whole process. They love to go on excursions to collect seeds. When they've helped to plant and tend young trees in the nursery, they'll also be more protective of the trees when they're planted out in the main schoolyard. Invite students from all grade levels to participate if possible.

As with any schoolyard project, it helps to involve as many people as possible. Make sure the caretakers know what you are doing and are supportive. Maybe they will even help to water now and then. Perhaps a parent in the community can help you identify trees or would love to help collect seeds. Members of local horticultural or field naturalist clubs can also be valuable resource people.

Although growing your own trees takes longer than buying them, starting a tree nursery can be a wonderful foundation for all schoolyard projects, and a fabulous opportunity to make positive links with the living world around us.

Green Teacher Magazine is an excellent resource for teachers. Their phone number is 416-960-1244 (Canada).

Where the Wild Things Are

Laura Sessions Stepp

Reprinted with permission from the Washington Post *April 22, 1996.*

Using Nature to Build Living & Learning Skills

The man in the red cap with a quilted largemouth bass poking through it is explaining the rules for learning in the outdoors. "Stay behind me when we're walking," Mr. Bass tells the third-graders from a South Arlington school. "When we stop, I'll roll this out"—he produces a purple grosgrain ribbon—"and I want you to stand behind it."

Snap! Nine-year-old Darrius Hawkins breaks a skinny hickory branch with his hands. Snap! again. Magically, two sticks become four. While Mr. Bass, (aka Neil Heinekamp), acting director of Arlington's Outdoor Lab, continues to talk, Darrius's eyes drift to a nearby stream where spotted salamanders have laid hundreds of eggs and tiny brown tadpoles have turned into frogs.

The roughness of tree bark, the gelatinous mass of amphibian eggs, even the tickle of a frog's legs as it hops across a palm...for most of human history, natural experiences such as these have been as much a part of childhood as food and shelter and scolding parents.

But over the last generation, opportunities for exploration of the natural world—particularly unstructured, playful exploration—have shrunk for many children even as a small but growing body of research shows such contact is important for healthy development. More and more, kids are playing indoors, leaving some experts to wonder whether this may help explain the dips in achievement, conduct disorders, signs of stress and acts of violence increasingly reported among U.S. children.

"Physical experiences are a significant part of brain development," says Laura Thurman, an early childhood education instructor at the University of Missouri's Child Development Center. "If we deny children these experiences we should not wonder why they're struggling in so many other areas."

One reason nature is such a successful laboratory for learning, social scientists say, is that it virtually begs young children to use their imagination and their hands, to take things apart and put them back together in new ways.

Psychologists call this "complex play" because of the multiple skills it uses, and they distinguish it from structured, rule-based games that require less original thinking.

Free play outdoors involves "almost every competency one can imagine - observing, inventing, problem-solving, decision-making," says Susan Miller, professor of early childhood education at Kutztown (Pa.) University. It also gives a child endless ways "to try something, fail, and try again."

Just being outdoors is not enough, however; grass and trees and small creatures are important too. William Sullivan, professor of environmental design at the University of Illinois, sent observers into a large housing development in inner-city Chicago to watch more than 200 children outside. According to his preliminary findings, kids on the blacktop or barren ground tended to stand around and talk, but on plots of ground with grass and trees they played.

For more than a decade educators have said that children learn best when they not only see a concept and hear it explained but also connect it to something with which they can experiment, something that allows them to touch, smell or taste.

Recent studies on the brain explain why this is so: The brain develops first through sensory experiences; later, words and other symbols also become important. "Smells and sights and sounds all become encoded as part of one experience," says Cosby Rogers, professor of child development at Virginia Tech University.

The more often a young child uses all the senses, the more neurons are fired in his or her brain. Specific knowledge is retained longer when multiple senses are used, according to University of Oregon education professor Robert Sylwester, and the brain's circuitry becomes increasingly sophisticated and ready to learn more.

Several studies have suggested that nature also has a capacity to help children pay attention. Autistic children, for example, have been shown to become more focused if encouraged to interact with dogs, cats, turtles and other animals. In another

study, the attentiveness of young students in Swedish schools that offered easy access to nature was compared to the attentiveness of students in schools that did not provide such access. The former students had fewer attention problems, according to Stephen Kaplan, professor of psychology at the University of Michigan.

The third-graders from Arlington's Glencarlyn Elementary squat around a battered beige pickup, supposedly watching Mr. Bass demonstrate how a screw works by jacking up the truck's right rear tire. Simple machines are the main lesson this day at the "lab," 200 acres of Fauquier County forest. At this moment, however, Stephanie Miranda is more interested in convincing a twig to stand upright in the hard red clay. A nearby boy hands her a stick that is pointed at one end and she succeeds in planting it. She places an oak leaf banner on top, and nudges her friend. They exchange grins.

In class, old rules about competition and achievement apply. So do divisions along gender lines. Outside, the barriers break down. In their book "The Geography of Childhood: Why Children Need Wild Places," naturalists Gary Paul Nabhan and Stephen Trimble cite a study by Robin Moore, a planner who helped redesign an elementary school playground in Berkeley, Calif. An asphalt playground was modified to include a half-acre of fishing ponds, streams, woods and meadows. Moore then spent time observing how the boys and girls played on both concrete and grass.

Boys and girls were more likely to play together in the natural areas, he reported; the asphalt "generated more conflict and stress, particularly between the sexes." According to Susan Miller, similar observations were made by teachers at an ethnically diverse school in South Texas. The school enlarged its outdoor play area, adding a sand pit and water tables and planting vegetables and flowers. Children were given more time to play outside. "The teachers were surprised at how well the children cooperated," she says.

Author Trimble attributes this cooperative learning partly to the diversity nature presents. "Cone-nosed kissing bugs and star-nosed moles...sharks, fireflies and bats...The endless forms generated by evolution subconsciously reassure us of our own validity," he writes. "No matter that we differ from our peers: Difference is the norm. Understanding difference empowers us to grow and to care."

Natural settings reduce stress and boost mental and physical health among adults, many studies have shown, so it should

come as no surprise that young people experience the same benefits. Yet children's participation in the outdoors is declining, according to the Outdoor Recreation Coalition of America.

Some of the reasons are obvious. Low-income parents keep children inside because it's safer; middle-income parents, because it's safer or more convenient. Television and computers entertain and babysit. When children do venture out, it's often to an organized outdoor function such as soccer, or to an indoor fantasy world such as Discovery Zone, the plastic playground concept that has spread to more than 300 franchised stores in six years.

While growing numbers of elementary schools are encouraging more outdoor learning, too many still keep kids indoors except for 15-minute recess periods, says education professor Miller. That's partly because teachers are not trained in college how to teach outdoors, says Susan Johnson, director of environmental education for the National Wildlife Federation.

As naturalist Michael Link writes in his book "Outdoor Education," "A classroom without walls...creates a picture of unbridled behavior problems, students disappearing over the horizon in defiance and a general nightmare of unanswerable questions and uncatchable kids. The result is that most students receive formal education indoors and must then apply it to the outside world on their own."

Even children's knowledge about the outside world is learned largely indoors, according to Nabhan and Trimble. Nabhan cites a 1992 survey of fifth and sixth graders in which more than half of the children cited the media as their primary teacher about the environment. Roughly one out of three gave school the credit, and fewer than one out of 10 said they learned about the environment mostly at home or in the wild.

Nabhan and Trimble deplore this trend toward vicarious learning, saying children will not retain their knowledge of nor affection for the natural world in the same way that previous generations did.

Environmentalists look at the trend and wonder where future warriors in the environmental movement will come from. Most adults who feel an affinity for the environment developed that regard in childhood, they say. What happens to children who don't have the same outdoor opportunities as previous generations? "What is the extinction of the condor

to a child who has never seen a wren?" asks ecologist/author Robert Michael Pyle in the Nabhan-Trimble book.

Peter H. Kahn Jr., a psychologist, interviewed African-American children in inner-city Houston about their environmental views and found that although they were aware of environmental problems, few believed that Houston was polluted. "Houston is one of the most polluted cities in the county," says Kahn, who teaches at Colby College in Maine. "How could children who live there and know about pollution not believe it's there?"

To know that a place is polluted, a child needs to have seen unpolluted places, Kahn concluded. "It is imperative that we get kids out to experience nature, open areas, less polluted states," he say.

Kahn's study helps dispel the notion, left from the early days of environmental politics, that nature studies are of little interest to low-income minority groups. True, the Houston children had pressing concerns about having enough to eat and where they could play safely. But they also "showed amazing diversity in the ways they appreciated and were committed to environmental issues," he says.

Environmentalists, child psychologists and others have advanced several ideas in recent years to increase outdoor opportunities for kids: schoolyard space transformed into natural habitats, parks built close to schools, public transportation provided to parks and park supervision increased.

But such efforts frequently get bogged down in adult debates over budgets and ideologies. School systems that attempt to weave outdoor education into their curricula, for example, sometimes find themselves caught between those who want to encourage kids both to think about the natural world and work on its behalf, and those who believe advocacy has no place in school.

Both camps do agree that children should be exposed to the natural world early and often, and that parents and grandparents are the best exposers/explainers. "It's important children understand their backyard first and gradually work outward," says Jo Kwong, an environmental research associate in Fairfax who is a critic of activism in the schools.

Naturalist Nabhan, a father of two, agrees: "We need not

pretend we are bosom buddies with aloof predators...Real attention given to a covey of quail, a swarm of termites, a litter of pack rats will do for most kids I know."

A couple of days after their visit to the Outdoor Lab, Darrius and three friends sit around a table at school and talk about what they liked about the field trip.

The high points:

"When I touched the frog," says Joel Velasquez.
"The three turtles," says Victoria Marcana.
"Holding the snake," says Daniela Zunita.

Darrius is quiet. He is remembering that moment, near the end of the morning session, when he got a bit rowdy and evoked a strong reprimand from his teacher, Scott Cleveland. At the time he stalked off, and sat on a hillside overlooking a pond.

"I felt sad, like my heart stopped beating," he recalls later in school. But he says that as he sat there, he imagined swimming in the pond with swift, sure strokes. A few minutes later he was able to rise and join the group.

He remembers that moment too. "I felt happy," he says, "like my heart was beating really fast."

Economic Incentive for Naturalizing School Grounds

In 1997, the U.S. Fish and Wildlife Service asked school facilities managers in Maryland to fill out a short questionnaire. Only two out of 24 were returned. The results of one questionnaire reveal the potential economic savings from naturalizing parts of school grounds.

The following are the results from the questionnaire returned from the Baltimore County School System in Maryland.

1. Total number of school sites you supervise. *161*
2. Total number of acres of turf grass managed. *2,400 acres*
3. Number of acres that have been turned into low-maintenance natural landscapes. *35 acres.*
4. Estimate the percentage that could be converted into low maintenance natural landscapes. *20-25 percent*
5. What is the cost/acre/year of maintaining turf-grass on school campuses (including mowing, watering, aeration, thatching, fertilizer, weed killers)? *$561 based on 1994 county audit*

Conclusion

20 percent of 2,400 acres = 480 acres
480 acres x $561= $269,280

Converting 20 percent of unused turf on school grounds to natural landscapes could save approx $270,000 in mowing costs each year.

Note: There would be some maintenance costs associated with natural areas, although much less than mowing costs.

North East Middle School Wetland

An Outdoor Classroom in the Making

by Laura O'Leary and Rose Grear

In August of 1994, the process of beginning a schoolyard habitat began at North East Middle School. A site was considered and inspected by the Cecil Soil Conservation and the United States Fish and Wildlife Service and was found to have sufficient water to sustain a wetland habitat even during seasonal drought periods. During the following school year, the students planned the layout of their wetland and decided on what kind of plants would be planted in their wetland. By May 19, 1995, over 400 plants had been planted by over 250 seventh grade students in our wetland habitat.

The North East Middle School wetland is approximately 5,000 square feet with a maximum depth of about 12 inches. A 250' x 30' wildlife corridor connects the wetland to a stream on the school property. The stream is a tributary to the Chesapeake Bay. Our children learn that their wetland helps to filter pollutants and nutrients and keep them from reaching the Bay.

Over 250 children participated in the planning, construction, and planting of the wetland in the 1994-1995 school year. Since then, more than 500 students have used the wetland as a living classroom. Not only is the wetland used very often in science classes, but we were able to train our whole staff on the "Wonders of Wetlands," and now the other disciplines are using the wetland as a teaching tool also.

Our wetland has attracted many forms of wildlife. Even before we were finished with construction, a Canada goose couple and a mallard couple had taken up residence. The Mallards still live there today, and we are hoping for a family this spring. Our students have seen numerous dragon and damselfly species, and the butterflies are abundant. The frogs have invaded to eat the insects, and turtles help to keep the algae down. Our most impressive visitor was a red-tailed hawk that came to sit on our wildlife habitat sign.

Many people and organizations were instrumental in the establishment of our wetland. The following is a list of agencies involved:

Lockheed-Martin Corporation	$1,000
Chesapeake Bay Trust	$1,000
Eastern Shore Consortium	$1,000 (school improvement grant)
Town of North East	$250
Cecil County Forestry Board	$1,000 worth of trees
Cecil Soil Conservation	Survey and design funding
U.S. Fish and Wildlife Service	Consultation and design for flora and fauna
Maryland Department of Natural Resources	Help planting trees
Heartwood Landscaping and Tree Service	Help planting trees
Edward Howell Excavation Inc.	Donated time, labor and equipment to excavate the wetland

Without the help of the above agencies, our wetland would not have happened. We are very thankful for the enthusiasm of everyone involved. Our students have a renewed attitude about the value of nature in their lives. The wetland has awakened in them a sense that it is their personal responsibility to help preserve their wetland and all of nature for future generations.

Bird House Specifications

Species	Preferred Habitat	Width (inches)	Height (inches)	Entrance Size (inches)	Entrance Ht Above Floor (in)	Height of House (feet)	Special Tips
Barn Owl	Open canopy woodlands or edges of thick woodlots	22	18	10" sq.	centered	in building	2" of woodchips on bottom
Barred Owl	old growth, wetland forests	12	24	7	12	20-30	3" of woodchips on bottom a perch should be close but not blocking entrance
Brown-headed nuthatch	pine woodlands	4	10	1¼	7	10-25	outer material should be pine bark
White-breasted nuthatch	deciduous woodlands	4	10	1 ¼	7	6-25	outer material should be bark
Carolina wren	woodlands with thick underbrush	4	8	1 ½	1-6	6-10	house can be hung from limb or house eave
Carolina chickadee	all woodlands	4	8	1 ¼	6	4-10	place house in area with 1/2 sunlight
Common Flicker	all woodlands	7	24	2 ½	18	8-20	fill house tightly with sawdust, outer material should be bark
Downy woodpecker	all woodlands	4	10	1 ¼	7	8-25	fill house tightly with sawdust, outer material should be bark
Eastern bluebird	open fields and golf courses	5	9	1 ½	5	4-8	place house in open area facing and about 10 feet away from a bush or along a wire fence
Eastern screech owl	woodland edges	8	16	3	10	15-30	3" of woodchips on bottom
Great crested flycatcher	all woodlands	6	10	2	6	8-20	place house in shade
Hairy woodpecker	all woodlands	6	15	1 ½	10	12-25	fill house tightly with sawdust, outer material should be bark
Pileated woodpecker	old growth woodlands	11	24	4	18	20-30	2" thick boards, fill tightly with sawdust, outer material should be bark

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Species	Preferred Habitat	Width (inches)	Height (inches)	Entrance Size (inches)	Entrance Ht. Above Floor (in)	Height of House (feet)	Special Tips
Prothonotary warbler	swamps and along rivers	4	8	1 ¼	6	2-12	place house next to or over water
Purple martin	open fields, yards and golf courses	6	6	2 ½	1	10-20	must have several compartments, place house on pole at least 25' from trees, other tall structures
Red-bellied woodpecker	all woodlands	7	15	2	10	20-40	fill tightly with sawdust, outer material should be bark
Red-headed woodpecker	open canopy woodlands and edges	6	15	2	10	20-40	fill tightly with sawdust, outer material should be bark
Southeastern American kestrel	open areas and edges of woodlots	9	16	3	11	15-30	2" of woodchips on bottom
Tufted titmouse	all woodlands & edges	4	10	1 ¼	7	4-15	place house in shade
Wood duck or Hooded merganser	bottomland hardwoods and wetlands	10	24	4x3 horiz. oval	20	4-6 over water 15-25 over land	4" of woodchips on bottom 18"x3" strip of hardware cloth on inside below entrance

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Resources

General

A Sand County Almanac. Leopold, Aldo. Ballantine Books, New York, New York, 1949. A classic essay about ecology and land management.

Grounds for Examination. Video. Learning through Landscapes. This video looks at the secondary school site and deals with: image and ethos; social interaction; curriculum organization; environmental stewardship. Call the Green Brick Road at 800/473 3638. $35.

Grounds for Celebration. Video. Learning through Landscapes. Presented by Sir David Attenborough, this inspirational video shows how one school has turned its modest grounds into a hugely valuable educational resource. Call the Green Brick Road at 800/473 3638. $25.

Grounds for Change. Video. Learning through Landscapes. This video produced by the Evergreen Foundation, explores the positive impact of school ground naturalization featuring planners, ecologists, teachers and students sharing their discoveries. Call the Green Brick Road at 800/473 3638. $15.

Making the Best of Your School Grounds. Video. Learning through Landscapes. This video will help you take a detailed look at your school grounds and will encourage you to undertake a process of change which will greatly enhance your student's learning environment. Call the Green Brick Road at 800/473 3638. $30.

Noah's Garden, Restoring the Ecology of Our Own Back Yards. Stein, Sara. Houghton Mifflin Company, New York, New York. 1993. Through her own experience, the author provides a proactive rationale for changing the American lawn into something more beautiful, interesting, and alive. ISBN # 0-395-65373-8.

The Field Guide to Wildlife Habitats (two volumes, Eastern and Western United States). Benyus, Janine. M. Simon and Schuster, 1989. Guides include definition of habitat, observation tips, profile of each habitat, charts, maps, illustrations, keys and specific information on individual species. Fireside Books. $14.95.

The Bird Feeder Book. Stokes, Donald and Lillian. Little, Brown and Co., 1987. Guidelines on attracting more birds to your yard, identifying species, and understanding bird behavior at feeders. Little, Brown and Co., Boston, MA. $8.95.

The Butterfly Book. Stokes, Donald and Lillian, and Williams, Ernest. Little, Brown and Co., 1991. An easy guide to butterfly gardening identification and behavior. Little, Brown and Co., Boston, MA. $11.95.

Child Play and Playground Design

Plants for Play: A Plant Selection Guide for Children's Outdoor Environments. Moore, Robin C. Learning through Landscapes, 1993. A reference manual with more than 200 plant species listed in this informed guide to creatively include plants in children's play settings. Call the Green Brick Road at 800/473 3638. $24 Canadian.

Play, Playtime & Playgrounds: Key Issues for Teachers/ Supervisors of Primary Schools. Titman, Wendy. Learning through Landscapes, 1992. This teacher's guide raises the issues related to the use of school grounds for play and playtime in primary schools. Call the Green Brick Road at 800/473 3638. $5 Canadian.

The Great Outdoors, Restoring Children's Right to Play Outside. Rivkin, Mary S. National Association for the Education of Young Children, 1995. The author sounds the call for schools and communities to restore children's outdoor play opportunities and practical ideas for bringing the great outdoors to your schools. ISBN # 0-935989-71-4.

Thinking About Seating in Your School Grounds. Russell, Lisa. Learning through Landscapes, 1991. A CD ROM helps you to explore all the issues connected with choosing, developing, locating and using seating in your school grounds. It is designed to be used by educators with students of all ages. Call the Green Brick Road at 800/473 3638. $22 Canadian.

Schoolyard Enhancement

A Guide to Management & Maintenance of School Grounds. Wood, Jane and Littlewood, Michael. Learning through Landscapes, 1996. This guide is designed to help schools develop a plan to efficiently maintain all aspects of their school grounds. Call the Green Brick Road at 800/473 3638. $26 Canadian.

A Citizen's Streambank Restoration Handbook. Firehook, Karen and Doherty, Jacqueline. Izaak Walton League, Gaithersburg, Maryland. 1995. Guide to understanding watersheds, diagnosing stream health and planning a restoration project. Call 800/BUG-IWLA.

Conserving and Enhancing the Natural Environment: A Guide for Planning, Design, Construction, and Maintenance on New and Existing School Sites. Maryland State Department of Education, 1999 To order call 410-767-0098. $18

Gardening for Nature. Virginia Museum of Natural History. Virginia Museum of Natural History, 1993. A teacher's guide to hands-on activities for wildlife gardening.

Grounds for Learning: A Celebration of School Site Development in Scotland. Kenny, Kate. Learning through Landscapes, 1996. Drawing on the experience of schools across Scotland, this book aims to inspire and support schools interested in developing their grounds. Call the Green Brick Road at 800/473 3638. $25.00 Canadian.

Habitat Restoration: A Guide for Proactive Schools. Cheskey, Edward D. The Waterloo County Board of Education, 1993. Based on work with schools in Toronto. Includes information and tips on natural communities, design considerations, plant materials, etc. Call 800/567 3800. $20.

Homes for Wildlife. Wyzga, Marilyn, C. New Hampshire Fish and Game Department, 1993. Practical applications for enhancing schoolyards for wildlife and for creating outdoor classroom sites geared toward grades K - 6. Call 603/271 3211. $8.

Pond Design for Schools. Flatt, Graham. Learning through Landscapes, 1989. This booklet is a practical step by-step guide to help teachers and students with the construction, planting, and maintenance of a school ground pond. Call the Green Brick Road at 800/473 3638. $10 Canadian.

Prairie Restoration for Wisconsin Schools. Fifield Murray, Molly. Earthkeeping Program at the University of Wisconsin-Madison Arboretum, 1993. A how-to manual that includes prairie history, ecology, wildlife, curriculum ideas, and source of native prairie seeds and plants. Call 608/262 5522. $20 plus $3 for shipping and handling.

Schoolyard Ecosystems for Florida, A Guide for Planning, Installing, Maintaining, and Using. Schaefer, Joseph M., Donelin, Dan W., Linscott, Lester L., and Cronin-Jones, Linda. University of Florida, Tallahassee, Florida, 1995. Only available in Florida.

So You Want to Start an Outdoor Classroom. The Oklahoma Conservation Commission and The Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma.

Special Places; Special People. Titman, Wendy. Learning through Landscapes, 1994. This package is the result of a two-year research project that examined the influence of school grounds and children's views of the environment and the adults who spoil or cherish it. This manual assists schools and communities in the management of schools and their grounds. Call the Green Brick Road at 800/473 3638. $35.

The Challenge of the Urban School Site. Edited by Martin, D., Lucas, D., Titman, S., and Hayward, S. Learning through Landscapes, 1996. This book offers practical advice for urban schools wishing to holistically develop their school grounds environment. Call the Green Brick Road at 800/473 3638. $27 Canadian.

Using School Grounds as an Educational Resource. Young, Kirsty. Learning through Landscapes, 1990. This booklet provides ideas on ways to develop and use school grounds within the daily curriculum. Call the Green Brick Road at 800/473 3638. $7.

Wild School Sites, A Guide to Preparing for Habitat Improvement Projects on School Grounds. Schiff, Paul, Smith-Walters, Cindi. Western Regional Environmental Council, Inc. 1993. The purpose is to help students and teachers take responsible action to improve their community. Discusses planning, team building, implementing and provides case studies. Call 310/493 5627.

Outdoor Instruction

Art in the School Grounds. Keaney, Brian. Learning through Landscapes, 1996. Numerous artistic opportunities include subject areas of design, music, drama, and movement. Call the Green Brick Road at 800/473 3638. $21 Canadian.

Beekeeping: A Practical Guide to Beekeeping in the School Grounds. Dr. Feltwell, John. Learning through Landscapes, 1991. This guide provides many ways which beekeeping and the study of bees can be incorporated into different areas of the curriculum. Call the Green Brick Road at 800/473 3638. $7 Canadian.

Botany for all Ages. Hunken, Jorie and The New England Wild Flower Society. The Globe Pequot Press, 1994. Introduction to botany, designed around the principles of observation, experimentation, and self-expression and is filled with information and suggested activities using plants.

Bridges to the Natural World. Kane Patricia F., Roselet, Dale A., and Anderson, Karl. New Jersey Audubon Society, 1992. A natural history guide for teachers of grades Pre-K through 6th developed to help New Jersey teachers lead students to a better understanding of their local natural environment. ISBN # 0-9624065-1-1.

Bright Ideas: The Outdoor Classroom-Curriculum in the School Grounds. Keaney, Brian and Lucas, Bill. Learning through Landscapes, 1993. This activity based resource provides individual, self-contained curriculum ideas directed at teachers with little teaching experience in the outdoors. Call the Green Brick Road at 800/473 3638. $20 Canadian.

Butterflies: A Practical Guide to their Study in the School Grounds. Dr. Feltwell, John. Learning through Landscapes, 1991. This guide identifies how butterflies can be used to teach a wide spectrum of science concepts. Call the Green Brick Road at 800/473 3638. $7 Canadian.

English in the School Grounds. Kaeney, Brian. Learning through Landscapes, 1993. Encourage creative thought and develop speaking, listening, writing and reading skills within the context of outdoor elements. Call The Green Brick Road at 800/473 3638. $19.

Exploring Woodlands: A Cross-Curricular Approach to Investigations of Woodlands. Pearce, Tony. Learning through Landscapes. This in-depth exploration of woodlands provides cross-curricular, field-based activities plus follow-up classroom work suggestions. Call the Green Brick Road at 800/473 3638. $30 Canadian.

Geography in the School Grounds. Attenborough, Hare C. and Day, T. Learning through Landscapes, 1996. A range of exciting activities for practical work in geography using the school grounds as a resource. For grades K-6. Call The Green Brick Road at 800/473 3638. $21.

Hands-On Nature: Information and Activities for Exploring the Environment with Children. Lingelbach, Jenepher, Ed. Vermont Institute of Natural Science, 1986. This guide contains a wide variety of clearly focused hands-on activities on natural cycles, designs, adaptations and habitats.

Mathematics in the School Grounds. Rhydderch-Evans, Zoe. Learning through Landscapes, 1993. A range of exciting ideas for teaching math outdoors using outdoor features including ponds, animals, etc. Call The Green Brick Road at 800/473 3638. $19.

Minnesota School Nature Areas: Notes on Benefiting the Biomes. Nielson, Matt and the School Nature Area Project. School Nature Area Project, 1996. Background information and resources on Minnesota's biomes. Call 507/646 3599. $5.

Outdoor Wildlife Learning Sites, OWLS. Kansas Department of Wildlife and Parks. 1993. Guidelines for Kansas Schools to educate students in the areas of biology, wildlife, and our natural environment.

Pond Watchers, Guide to Ponds and Vernal Pools of Eastern North America. Massachusetts Audubon Society, Lincoln, Massachusetts, 1995. A full-color laminated three-fold field key to common pond and vernal pool life. Call Massachusetts Audubon at 617/259 9500.

Science in the School Grounds. Thomas, Gill. Learning through Landscapes, 1992. This book provides dozens of practical science activities done in the school grounds. Call the Green Brick Road at 800/473 3638. $19.

Sharing Nature with Children. Cornell, Joseph. CA: Dawn Publications, 1979. Guide with activities and games for young children designed to help participants learn ecological concepts and develop a closer affinity with the natural world. Contact bookstore.

Slugs, Snails & Earthworms: A Practical Guide to their Study in the School Grounds. Dr. Feltwell, John. Learning through Landscapes, 1991. A curriculum guide showing the ways of studying the world of worms and gastropods are explored in this guide. Call the Green Brick Road at 800/473 3638. $7 Canadian.

Ten-Minute Field Trips: A Teacher's Guide to Using the School Grounds for Environmental Studies. Russell, Helen Ross. National Science Teachers Association, 1990. Activities and ideas for using school grounds as a resource for relating textbook concepts to everyday life. Call 800/722 6782.

The Schoolyard Wildlife Activity Guide. Cronin-Jones. Florida Game and Fresh Water Fish Commission, 1992. Activity guide that includes 35 activities which focuses on the plants and animals commonly found in Florida schoolyards. Only available in Florida. Write to Florida Game and Freshwater Fish Commission, 620 South Meridian St., Tallahassee, FL 32399.

Trees. Clark, R. And Walters, P. Learning through Landscapes, 1992. Using trees as the focus, this guide contains twelve main activity themes and five class/school-wide projects. Call the Green Brick Road at 800/473 3638. $16.

WOW! The Wonders of Wetlands. Kesselheim, Alan S., Slattery, Britt Eckhardt, Higgins, Susan H., Schilling, Mark R. Environmental Concern Inc. and The Watercourse. 1995. Call Environmental Concern at 410/745 9620 or The Watercourse at 406/994 5392.

Habitat Restoration, Natural Landscaping, Plant Guides

American Wildlife and Plants, A Guide to Wildlife and Food Habits. Martin, Alexander C., Zim, Herbert S., and Nelson, Arnold L. Dover Publications, Inc., New York, New York, 1951. An extensive reference about the use of trees, shrubs, and herbaceous plants by birds and mammals of the United States. ISBN # 486-20793-5.

Backyard Wildlife Garden. Schneck, Marcus. Rodale Press, 1992. Identifies how to attract and identify wildlife in your yard. Rodale Press Book Reader's Service, 33 East Minor St., Emmaus, PA 18098. $24.95.

Creating Landscapes for Wildlife - A Guide for Backyards in Utah. Nordstrom, Sue. UT Division of Wildlife Resources, 1991. Guidelines for habitat enhancement, geared towards residential backyards. Call 801/538 4720.

Design of Storm Water Wetland Systems. Anacostia Restoration Team, Dept. Of Environmental Programs, 1992. Guidelines for creating diverse and effective stormwater wetlands systems in the Mid-Atlantic region. Send $25 (check) to MWCOG, 777 North Capital St., Suite 300, Washington, DC 20002-4201.

Growing and Propagating Showy Native Woody Plants. Bir, Richard. University of North Carolina Press, 1992. Covers more than 90 native plants in the Southern to Mid-Atlantic region. Provides color photos, natural history, landscape use and methods to grow and propagate.

Landscaping for Wildlife. Henderson, Carroll. Minnesota Department of Natural Resources, 1994. Landscape plans specifically created for the Midwest climate. Call 612/297 3000 or 800/657 3757. $10.95.

Meadows and Meadow Gardening. New England Wildflower Society. New England Wildflower Society, 1990.

Native Plants in the Creation of Backyard, Schoolyard and Park Habitat Areas. Mowery, Marci. Audubon Council of Pennsylvania, Camp Hill, Pennsylvania, 1995. Outlines the stages of planning a habitat garden, an understanding of wildlife needs and a detailed list of Pennsylvania native plants. Call Audubon Council at 717/763 4985.

Native Plants for Wildlife Habitat. Mason, Rich and Hitchcock, Jason. U.S. Fish and Wildlife Service, Annapolis, Maryland. 1995. An abridged guide to common native plants of the Mid-Atlantic states that are available through nurseries. Call U.S. Fish and Wildlife Service at 410/573 4500.

Plants in Wetlands. Redington, Charles B. Kendall/Hunt Publishing, Dubuque, IA, 1994. ISBN # 0-8403-89833. Provides key and secondary species for six major wetland types. Provides illustrations of each plant and detailed ecological relationships of the plant to other plants and animals.

Providing Wetlands for Wildlife While Controlling Stormwater. Brittingham, Margaret. Pennsylvania State University, College of Agricultural Sciences Cooperative Extension. A manual showing how stormwater management structures can be enhanced for wildlife. Publications Distribution Center, 112 Agricultural Administration Building, University Park, PA 16802.

Soil Bioengineering for Upland Slope Protection and Erosion Reduction. Sotir, Robbin B. and Gray, Donald H. U.S. Department of Agriculture, Soil Conservation Service, 1992. A manual detailing different techniques that use vegetation to reduce erosion from slopes. Call 202/205 0026.

The Natural Habitat Garden. Druse, Ken. Clarkson N. Potter, Inc., NY, 1994. ISBN # 0-517-58989-3.

The National Wildlife Federation's Guide to Gardening for Wildlife. Tufts, Craig and Loewer, Peter. Rodale Press, 1995. Rodale Press Book Reader's Service, 33 East Minor St., Emmaus, PA 18098.

The Natural Lawn & Alternatives. Plants & Gardens, Botanic Garden Record. Brooklyn Botanic Garden, Inc., 1993. An overview of several alternative practices to lawns. ISBN # 0-945352-80-8.

Wetland Planting Guide for the Northeastern United States. Thunhorst, Gwendolyn A. Environmental Concern, Inc., St. Michaels, MD, 1993. Consolidated information on wetland plants including characteristics, growth, planting, habitat, appearance, hydrology and wildlife benefits. Call Environmental Concern Inc. at 410/745 9620.

Woodworking for Wildlife. Henderson, Carroll. Minnesota Department of Natural Resources, 1994. Features numerous diagrams for building shelters for birds and mammals. Call 612/297 3000 or 800/657 3757, cost $9.95.

Native Plants vs. Invasive Species

Native or indigenous plants are adapted to the local soil, rainfall and temperature conditions, and have developed natural defenses to withstand many types of insects and diseases. Because of these traits, native plants will grow without much maintenance. Wildlife species evolve with plants; therefore, they use native plant communities as their habitat. Using native plants helps preserve the balance of natural ecosystems.

In contrast, many natural ecosystems have been degraded by exotic or non-native plants introduced from other parts of the world. Some of these introduced plants are invasive, meaning they do not have any natural controls and spread rapidly. Invasive plants can smother and compete with native vegetation. Ecosystems with invasive, exotic plants have less wildlife and plant diversity than unaffected systems. Do not plant the following as they are invasive in the Mid-Atlantic region.

Herbaceous

Creeping Bugleweed *Ajuga reptans*
Garlic Mustard *Alliaria petiolata (A. officinalis)*
Field Garlic *Allium vineale*
A grass *Arthraxon hispidus*
Long-bracted Beggar-ticks *Bidens polylepis*
Spotted Knapweed *Centaurea maculosa*
Canada Thistle *Cirsium arvense*
Bull Thistle *Cirsium vulgare*
Crownvetch *Coronilla varia*
Teasel *Dipsacus sylvestris*
Indian Strawberry *Duchesnea indica*
Tall Fescue, K31 Fescus *Festuca elatior (F. arundinacea)*
Gill-over-the-ground, Ground Ivy *Glechoma hederacea*
Yellow Daylily *Hemerocallis flava*
Common Daylily *Hemerocallis fulva*
Hydrilla *Hydrilla verticillata*
European Yellow Iris, Water Flag *Iris pseudacorus*
Henbit *Lamium amplexicaule*
Purple Dead Nettle *Lamium purpureum*
Sericea Lespedeza *Lespedeza cuneata*
Creeping Lilyturf *Liriope spicata*
Moneywort *Lysimachia nummularia*
Purple Loosestrife *Lythrum salicaria*
A grass *Microstegium vimineum (Eulalia viminea)*
Eulalia, an ornamental grass *Miscanthus sinensis*
Giant Chickweed *Myosoton aquaticum (Stellaria aquatica)*
Parrot's Feather *Myriophyllum brasiliense*
Star of Bethlehem *Ornithogalum nutans*
Nodding Star of Bethlehem *Ornithogalum umbellatum*
Beefsteak Mint *Perilla frutescens*

Reed Canary Grass *Phalaris arundinacea*
Common Reed *Phragmites australis (P. communis)*
An arum, resembles Green Dragon *Pinellia ternata*
Japanese Knotweed *Polygonum cuspidatum*
Giant Knotweed *Polygonum sachalinense*
Lesser Celandine *Ranunculus ficaria*
Johnson Grass *Sorghum halepense*

Vines

Porcelain Berry *Ampelopsis brevipedunculata*
Oriental Bittersweet *Celastrus orbiculatus*
Yam-leaved Clematis *Clematis terniflora (C. dioscoreifolia)*
Cinnamon Vine *Dioscorea oppositifolia (D. batatas)*
Climbing Euonymus, Wintercreeper *Euonymus fortunei*
English Ivy *Hedera helix*
Japanese Honeysuckle *Lonicera japonica*
Kudzu *Pueraria lobata*
Matrimony Vine *Solanum dulcamara*
Asian Tearthumb or Mile-a-minute Vine *Polygonum perfoliatum*
Periwinkle *Vinca minor*
Wisteria *Wisteria floribunda, W. sinensis*

Shrubs

Russian Olive *Elaeagnus angustifolium*
Autumn Olive *Elaeagnus umbellata*
Winger Euonymus, Winged Wahoo *Euonymus alatus*
Privet *Ligustrum spp.*
Bush Honeysuckles, including: *Lonicera spp.*
- Belle Honeysuckle *Lonicera x bella*
- Amur Honeysuckle *Lonicera maackii*
- Morrow's Honeysuckle *Lonicera morrowi*
- Tartarian Honeysuckle *Lonicera tatarica*

Bamboo - running varieties *Phyllostachys spp., Pseudosasa japonica*
Common Buckthorn *Rhamnus cathartica*
European Buckthorn *Rhamnus frangula*
Multiflora Rose *Rosa multiflora*
Strawberry-raspberry, Ballonberry *Rubus illecebrosus*
Wineberry *Rubus phoenicolasius*
Japanese Spiraea *Spiraea japonica*
Coralberry *Symphoricarpos orbiculatus*

Trees

Norway Maple *Acer platanoides*
Tree of Heaven *Ailanthus altissima*
Catalpa *Catalpa spp.*
White Mulberry *Morus alba*
Empress Tree *Paulownia tomentosa*
White spruce *Picea glauca*
White poplar *Populus alba*
Sweet Cherry, Bird Cherry *Prunus avium*